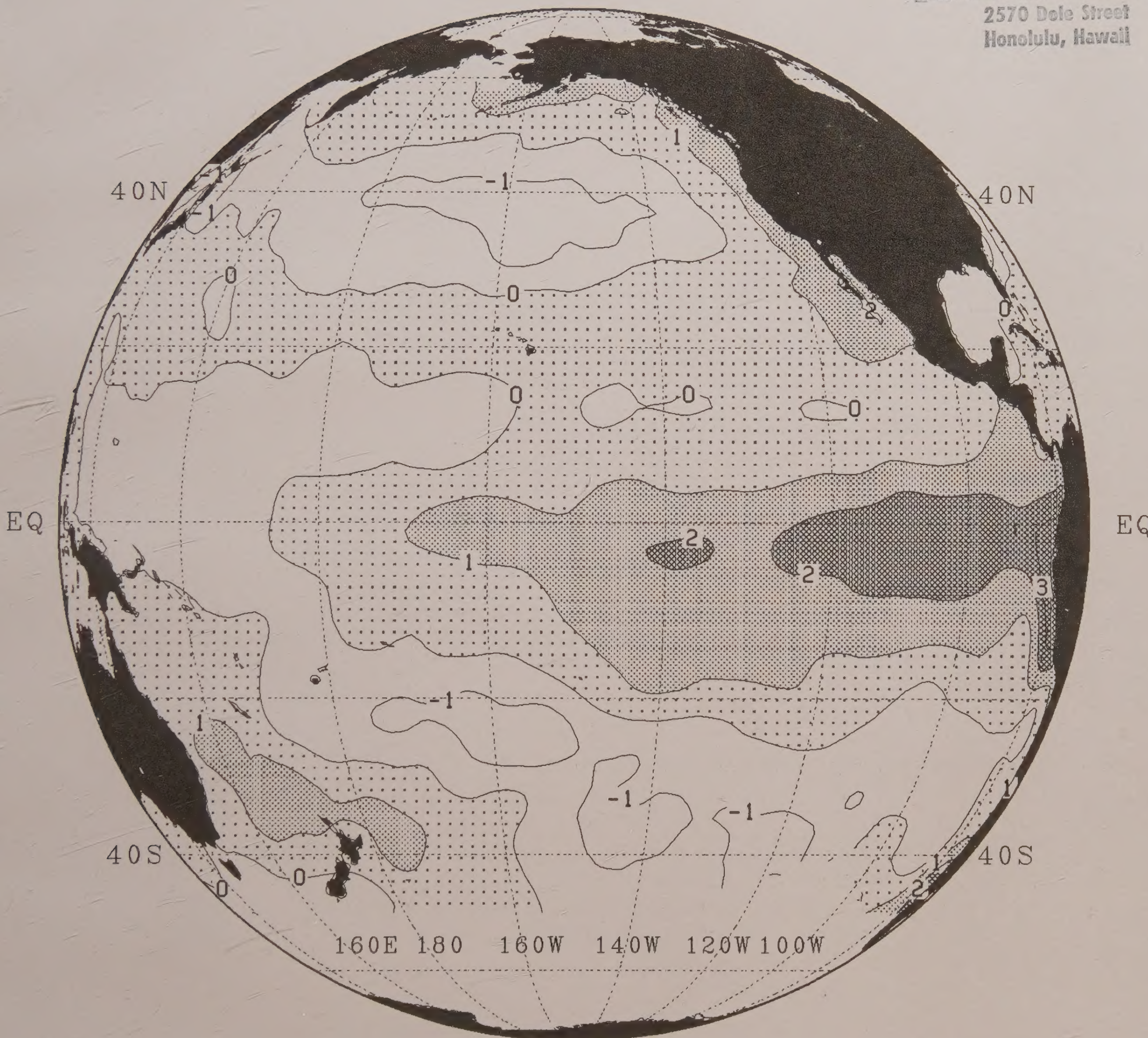
気象庁海洋月報

Monthly Ocean Report

March 1998 (No. 63)



Climate and Marine Department
Japan Meteorological Agency

気象庁 気候・海洋気象部

平成10年3月

気象庁海洋月報は、気象庁 気候・海洋気象部 海洋課で作成しています。

本月報に関する問い合わせは、

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Monthly Ocean Report is prepared by the Oceanographical Division, Climate and Marine Department, Japan Meteorological Agency.

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表紙は、1998年3月の太平洋の月平均海面水温偏差図です。

陰影部は、平年より高温の海域を示しています。

The figure on the front cover shows the monthly mean SST anomalies for March 1998 in the Pacific Ocean.

Areas of positive anomalies are shaded.

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海況の特徴（１９９８年３月）

日本近海の海況

海面水温は，本州の南で平年より１℃以上高く，北海道の南東から本州の東にかけて平年より１℃以上低かった（第4図）。

黒潮は，九州から紀伊半島にかけて接岸した後，東進し，八丈島付近を経て，房総半島沖を北東に流れていた（第9図）。

親潮系の冷水の沿岸寄りの分枝は37.9゜N，142.5゜Eまで達していた（第5図）。

太平洋の海況

太平洋赤道域の海面水温は，170゜W以東で平年より１℃以上高い状態が続いており，南米沿岸では＋3℃以上の海面水温偏差が見られた。エルニーニョ監視海域（4゜N～4゜S，150゜W～90゜W）の海面水温偏差は＋2.1℃に減少したが，海面水温は上昇を続け29.0℃となった（表1）。

北太平洋では，40゜N付近の175゜E～140゜Wで，引き続き-1℃を越える負偏差となっていた。北米沿岸の正偏差は先月より減少したものの，平年より1℃以上高い状態が続いていた。南シナ海では平年より１℃以上高かった（第16図）。

Highlights March 1998

Seas adjacent to Japan

Positive SST anomalies exceeded +1°C south of Honshu. SSTs were more than -1°C below normal from southeast of Hokkaido to east of Honshu (Fig. 4).

The Kuroshio flowed along the coasts from Kyushu to Kii Peninsula, then it flowed eastward. After passing near Hachijyo Island, it flowed northeastward off Boso Peninsula (Fig. 9).

Coastal branch of the Oyashio cold water extended southward to 37.9°N, 142.5°E (Fig. 5).

Pacific Ocean

In the equatorial Pacific, positive SST anomalies still exceeded +1°C east of 170°W and +3°C near the South American coast. The SST anomaly of El Niño monitoring region (4°N-4°S, 150°W-90°W) was +2.1°C. The actual SST value has increased to 29.0°C, though the magnitude of the anomaly in the region has reduced (Table 1).

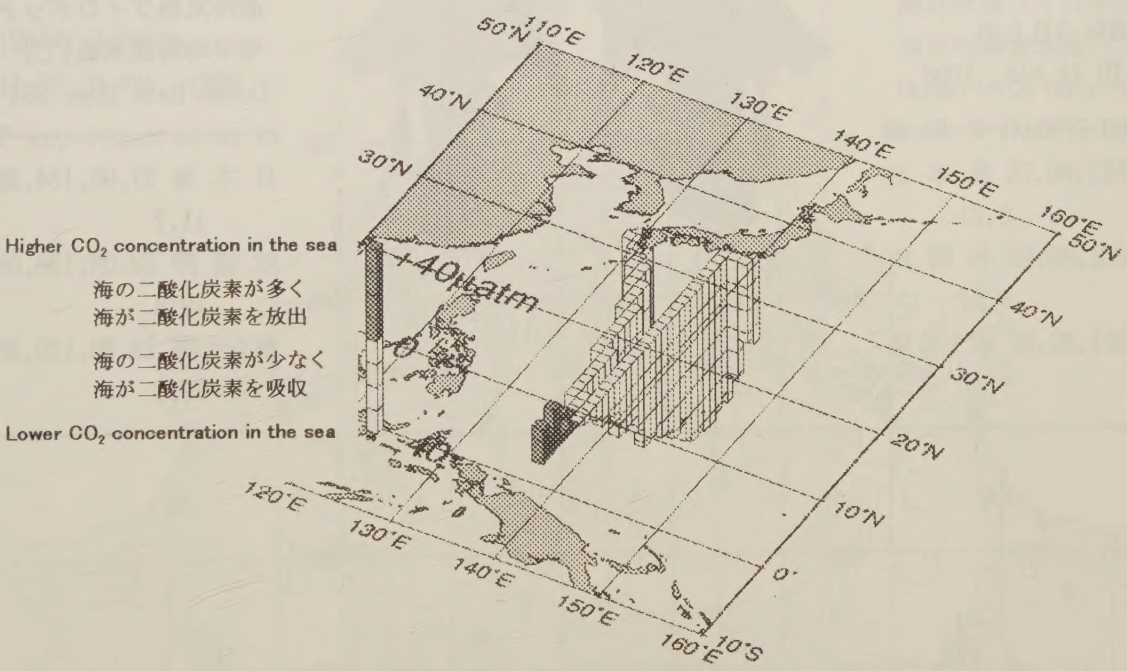
In the North Pacific, negative SST anomalies along 40°N still exceeded -1.0°C between 175°E and 140°W. Positive SST anomalies along the North American coast have reduced, but still exceeded +1°C. SSTs were more than 1°C above normal in the South China Sea (Fig. 16).

北西太平洋における二酸化炭素の観測

Observation of carbon dioxide in the western North Pacific

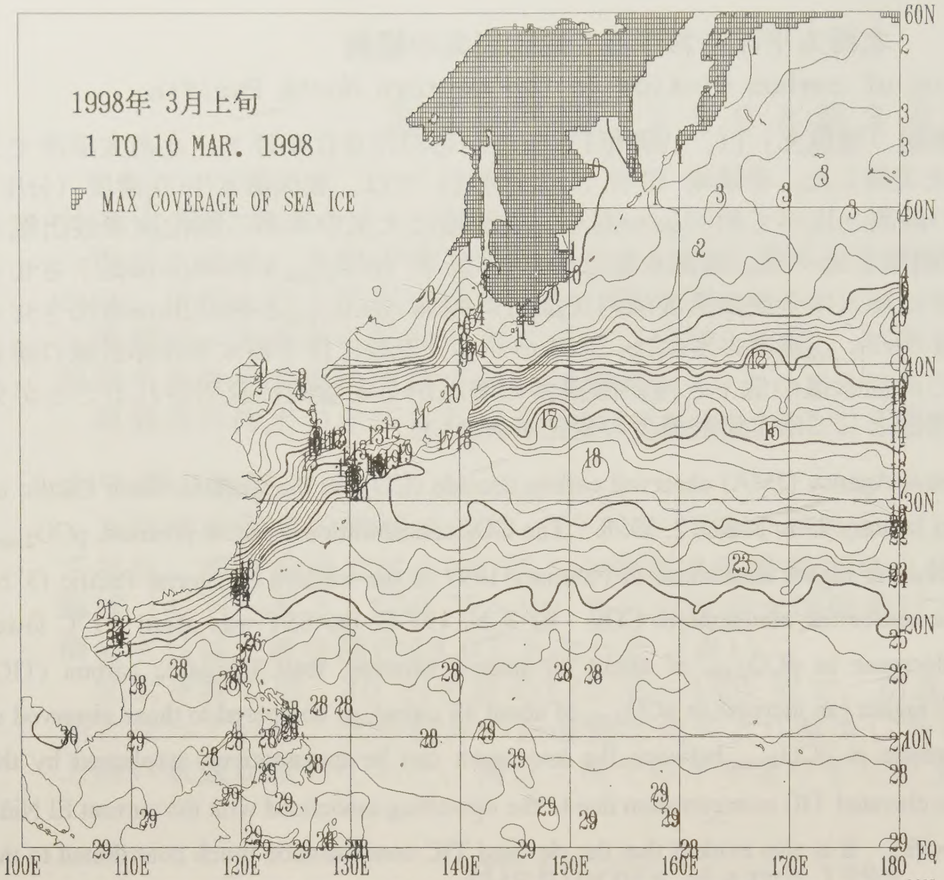
気象庁の海洋気象観測船「凌風丸」は、1998年1月27日から3月2日にかけて、北西太平洋で二酸化炭素（CO_2）の観測を実施した。赤道域（3°N、137°E付近）では、表面海水中CO_2濃度（分圧、$pCO_{2,sea}$）が、昨年2月の観測と比べて約20μatm高く、当海域は大気中への二酸化炭素放出域となっていた。昨年2月の観測と比べて、海面水温は約1.1°C低下（$pCO_{2,sea}$を約20μatm低下させる効果）している一方、表面海水中全炭酸濃度は約70μmol/l増加（$pCO_{2,sea}$を約40μatm増加させる効果）していた。赤道域の$pCO_{2,sea}$濃度の変化は、エルニーニョ現象に伴う西太平洋赤道域の湧昇に由来すると考えられる海面水温の低下と全炭酸濃度の増加から定量的に説明されることが分かった。$pCO_{2,sea}$変化の要因としては全炭酸濃度の変化が大きい。

The Japan Meteorological Agency (JMA) observed carbon dioxide (CO_2) in the western North Pacific on board R/V *Ryofu Maru* from January 27 to March 2, 1998. The CO_2 concentrations (partial pressure, $pCO_{2,sea}$) in the surface water were 20μatm higher than those in February 1997 in the western equatorial Pacific (3°N, 137°E) and this area was a source for atmospheric CO_2. At 3°N, 137°E, the SST was about 1.1°C lower (which corresponds to a decrease in $pCO_{2,sea}$ of about 20 μatm), whereas, total inorganic carbon (TIC) concentration was 70 μmol/l higher (an increase in $pCO_{2,sea}$ of about 40 μatm), as compared to those observed in February 1997. The difference in $pCO_{2,sea}$ between the two years can be quantitatively explained by the reduction of the SST and the elevated TIC concentration due to the upwelling associated with the current El Niño in the western equatorial Pacific. It is also evident that the elevated TIC concentration much contributed to the increase in $pCO_{2,sea}$.



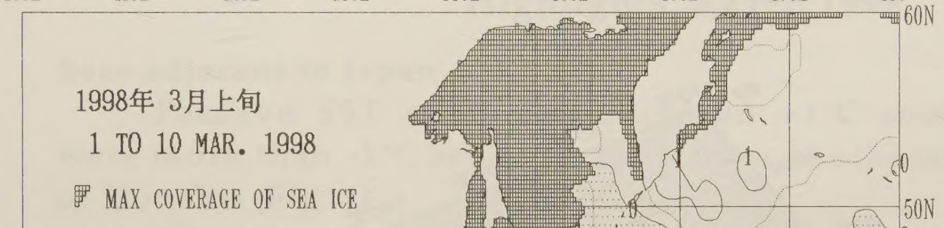
図A　気象庁の海洋気象観測船「凌風丸」が1998年1月27日から3月2日にかけて北西太平洋で観測した洋上大気中と表面海水中のCO_2の濃度差。棒グラフは、海洋から大気へCO_2を放出する場合を濃い陰影、および海洋が大気のCO_2を吸収する場合を薄い陰影に示してある。

Fig. A　Difference in the CO_2 concentration between the surface water and the overlying atmosphere in the western North Pacific observed by the R/V *Ryofu Maru* of JMA from January 27 to March 2, 1998. Darker-shaded upward pillars indicate that the oceanic CO_2 was being emitted into the atmosphere, and lighter-shaded downward pillars indicate that the atmospheric CO_2 was being absorbed into the ocean, respectively.



旬平均沿岸水温(℃)
Coastal Water Temperature

地点名 (Index Number)	水温 Temp.	偏差 Anom.
石　垣(47918)	22.4	1.2
御前崎(47655)	13.2	2.1
八丈島(47678)	18.9	2.4
小名浜(47598)	7.3	-1.5
宮　古(47585)	6.3	0.4
江　差(47428)	8.0	-
浜　田(47755)	12.5	-

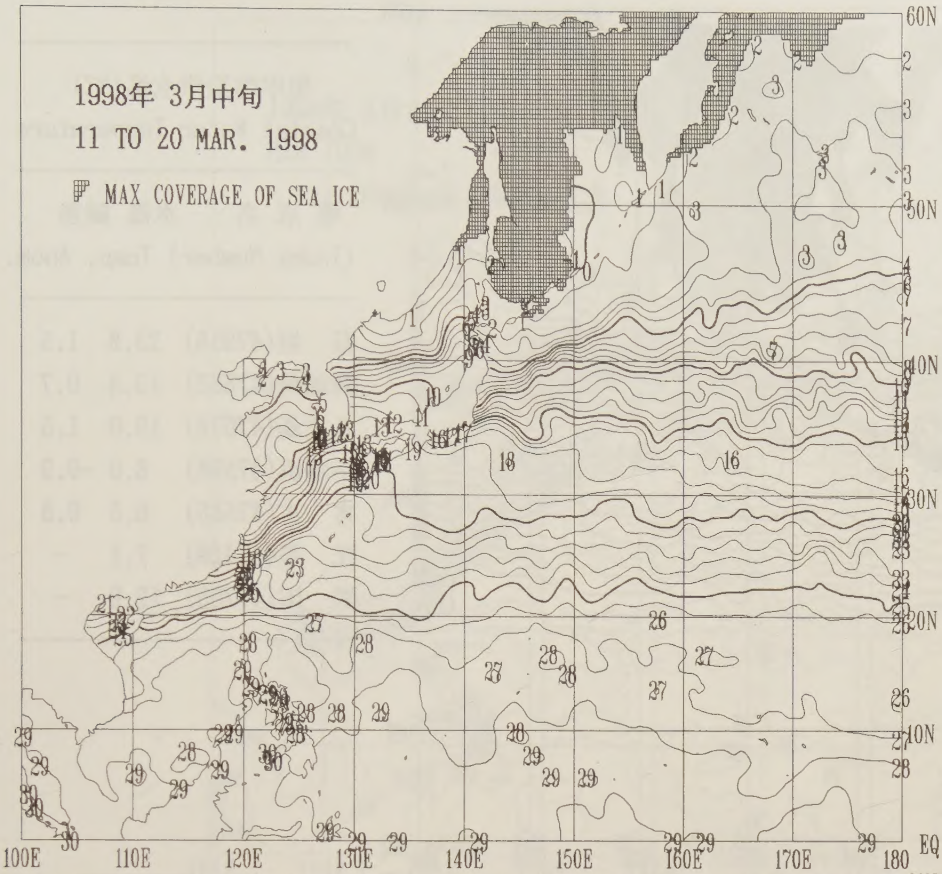


海洋気象ブイロボット
旬平均海面水温(℃)
Ocean Data Buoy SST

地点	位置	水温
日本海	37.9N,134.5E	11.2
四国沖	29.0N,135.0E	19.3
東シナ海	28.2N,126.3E	22.2

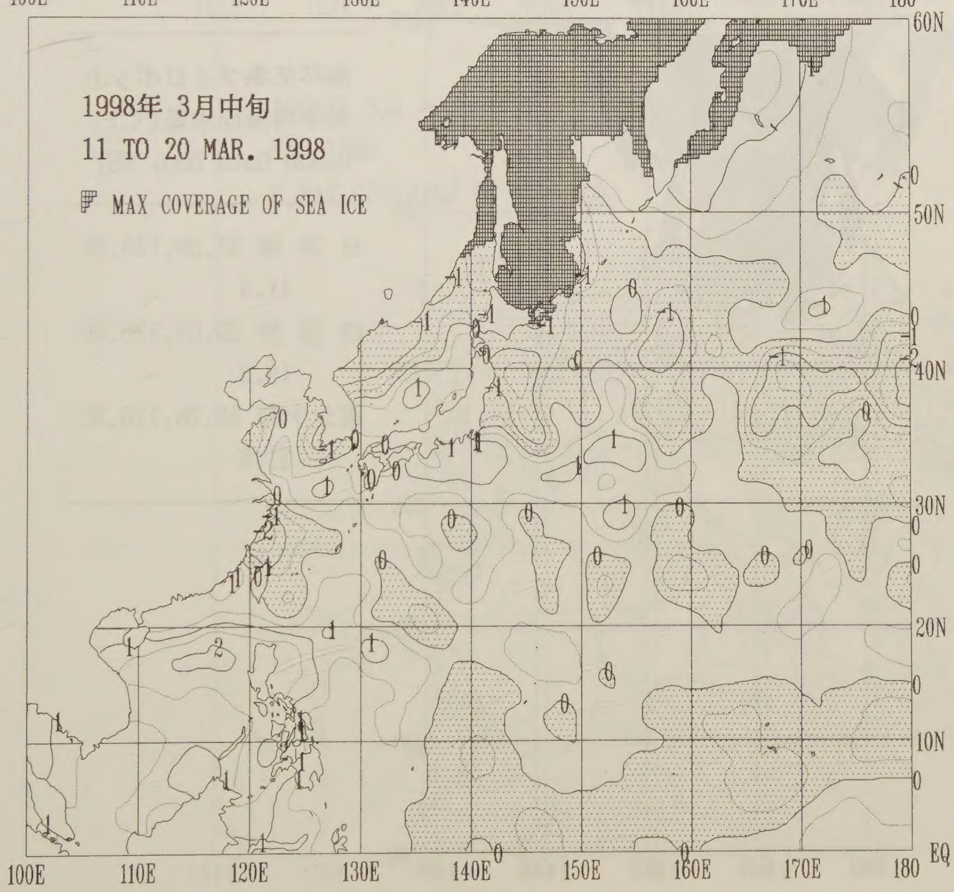
第1図 北西太平洋旬平均海面水温図(上)及び偏差図(下)(1998年 3月上旬)

Fig.1 Ten-day mean SST (top) and anomalies (bottom) in the western North Pacific for the 1st ten-day period in MAR 1998. Anomalies are computed from the JMA climatology (1961-90). Contour interval is 1°C and additional anomaly contours of 0.5°C are shown by broken lines. Negative anomalies are spotted.



旬平均沿岸水温(℃)
Coastal Water Temperature

地点名 (Index Number)	水温 Temp.	偏差 Anom.
石　垣(47918)	22.6	0.7
御前崎(47655)	12.6	0.8
八丈島(47678)	18.6	1.4
小名浜(47598)	7.5	-1.4
宮　古(47585)	6.3	0.7
江　差(47428)	6.7	-
浜　田(47755)	12.3	-

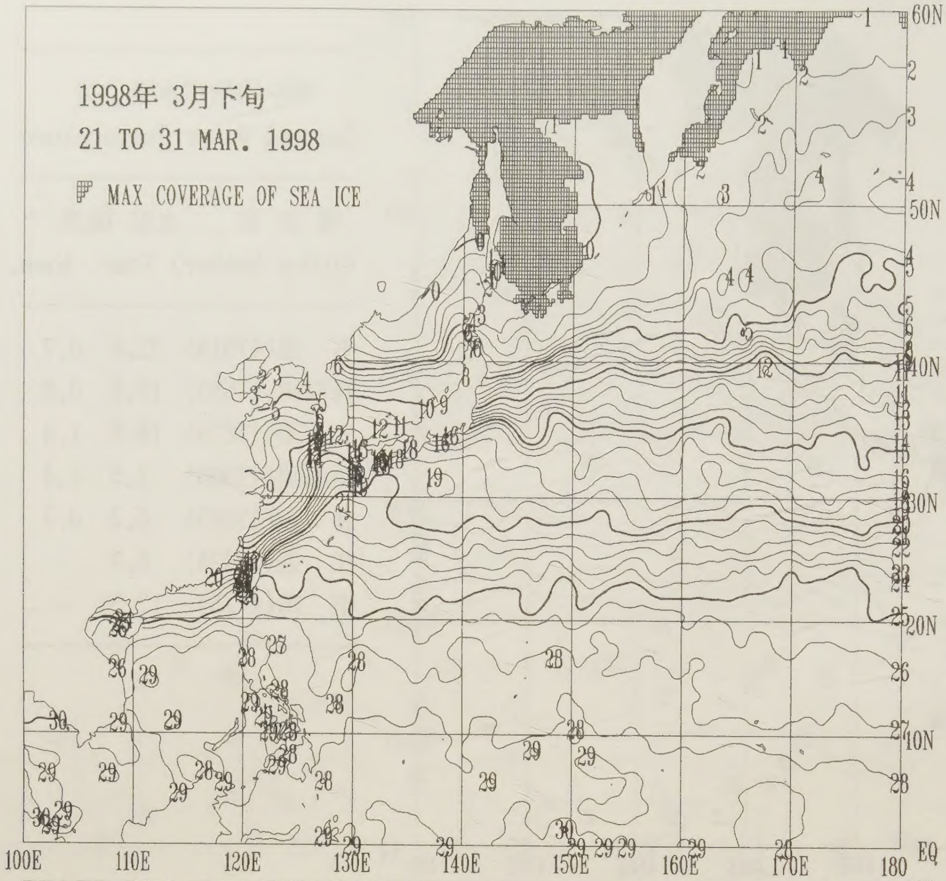


海洋気象ブイロボット
旬平均海面水温(℃)
Ocean Data Buoy SST

日本海	37.9N,134.5E 10.8
四国沖	29.0N,135.0E 19.0
東シナ海	28.2N,126.3E 20.5

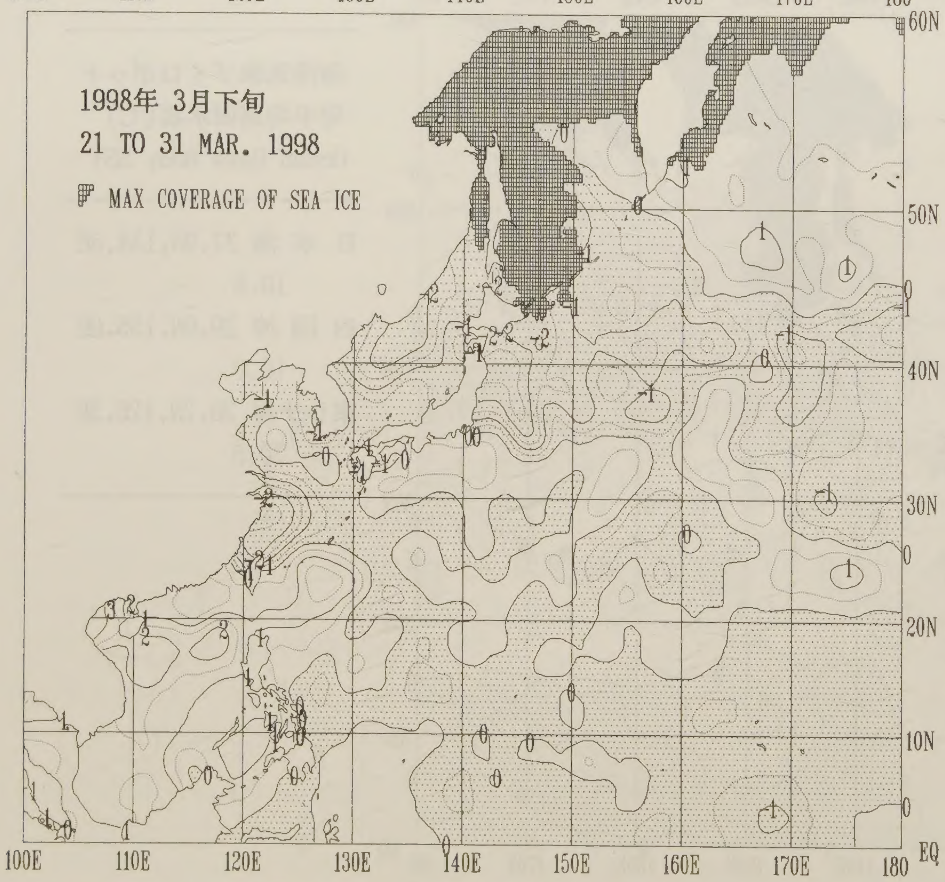
第2図 北西太平洋旬平均海面水温図(上)及び偏差図(下)(1998年 3月中旬)

Fig.2 Ten-day mean SST (top) and anomalies (bottom) in the western North Pacific for the 2nd ten-day period in MAR 1998. Anomalies are computed from the JMA climatology (1961-90). Contour interval is 1°C and additional anomaly contours of 0.5°C are shown by broken lines. Negative anomalies are spotted.



旬平均沿岸水温(℃)
Coastal Water Temperature

地 点 名 (Index Number)	水温 Temp.	偏差 Anom.
石 垣(47918)	23.8	1.5
御前崎(47655)	13.4	0.7
八丈島(47678)	19.0	1.5
小名浜(47598)	8.0	-0.9
宮 古(47585)	6.5	0.8
江 差(47428)	7.1	-
浜 田(47755)	12.9	-

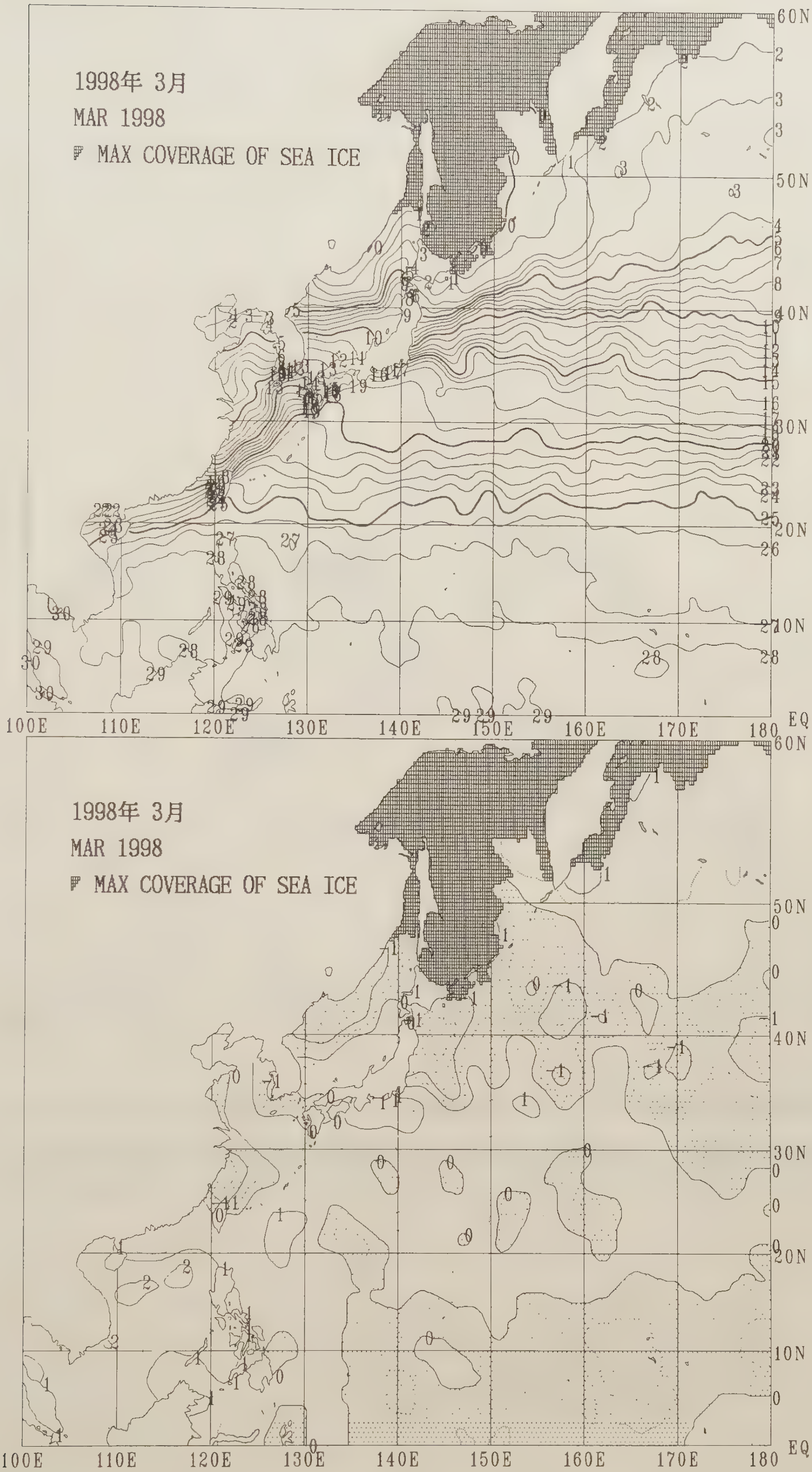


海洋気象ブイロボット
旬平均海面水温(℃)
Ocean Data Buoy SST

地点	位置	水温
日 本 海	37.9N,134.5E	11.4
四 国 沖	29.0N,135.0E	19.8
東シナ海	28.2N,126.3E	21.8

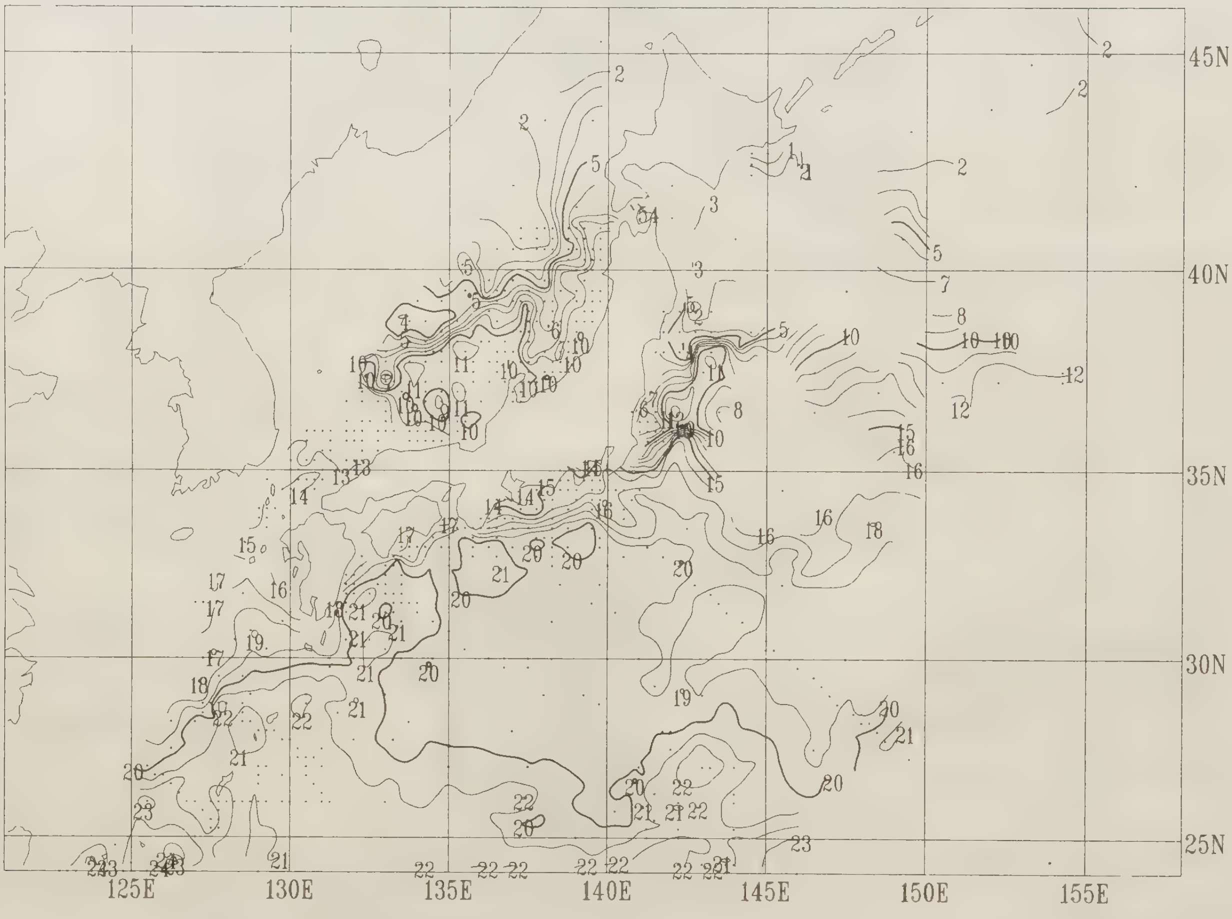
第3図 北西太平洋旬平均海面水温図(上)及び偏差図(下)(1998年 3月下旬)

Fig.3 Ten-day mean SST (top) and anomalies (bottom) in the western North Pacific for the 3rd ten-day period in MAR 1998. Anomalies are computed from the JMA climatology (1961-90). Contour interval is 1°C and additional anomaly contours of 0.5°C are shown by broken lines. Negative anomalies are spotted.



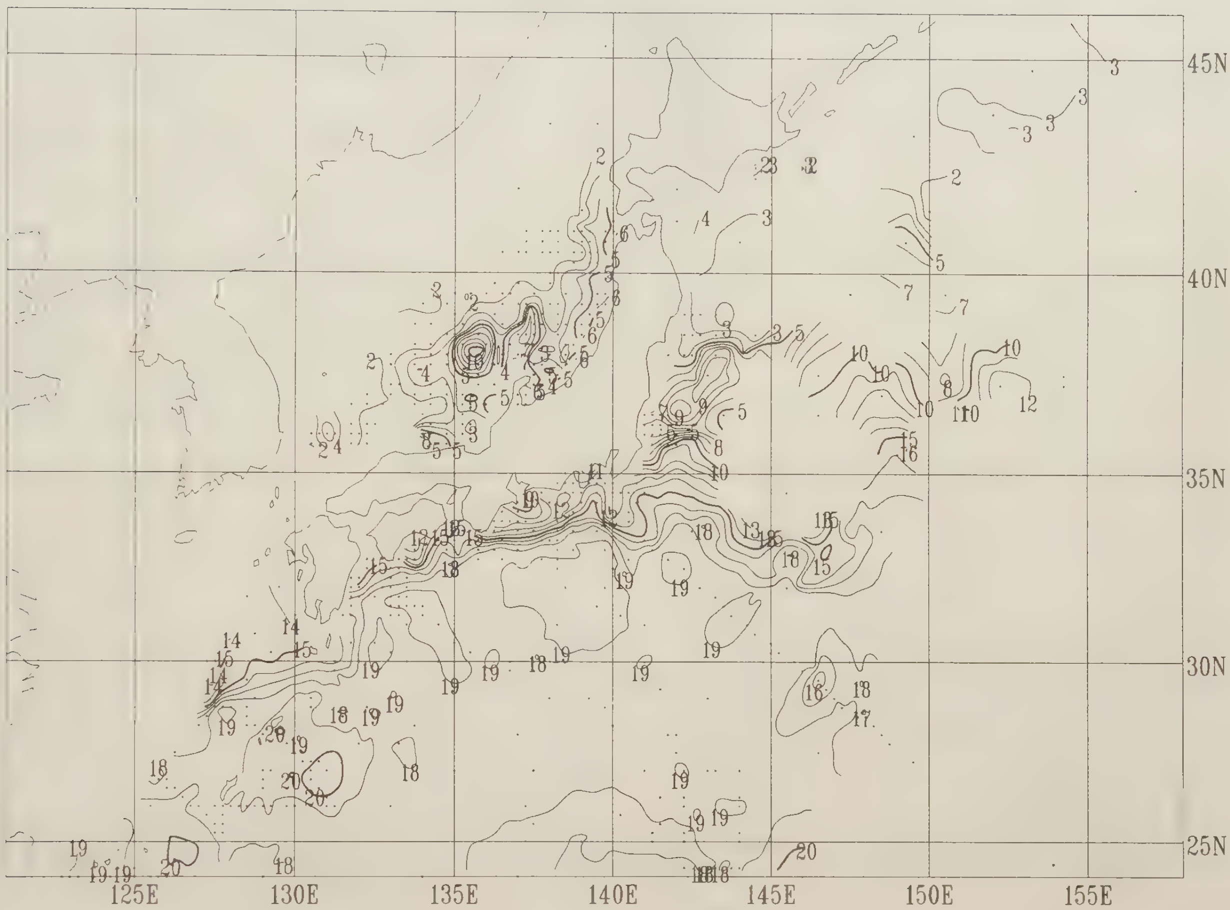
第4図 北西太平洋月平均海面水温図(上)及び偏差図(下)(1998年 3月)

Fig.4 Monthly mean SST (top) and anomalies (bottom) in the western North Pacific for MAR 1998. Anomalies are computed from the JMA climatology (1961-1990). Contour interval is 1°C and additional anomaly contours of 0.5°C are shown by broken lines. Negative anomalies are spotted.



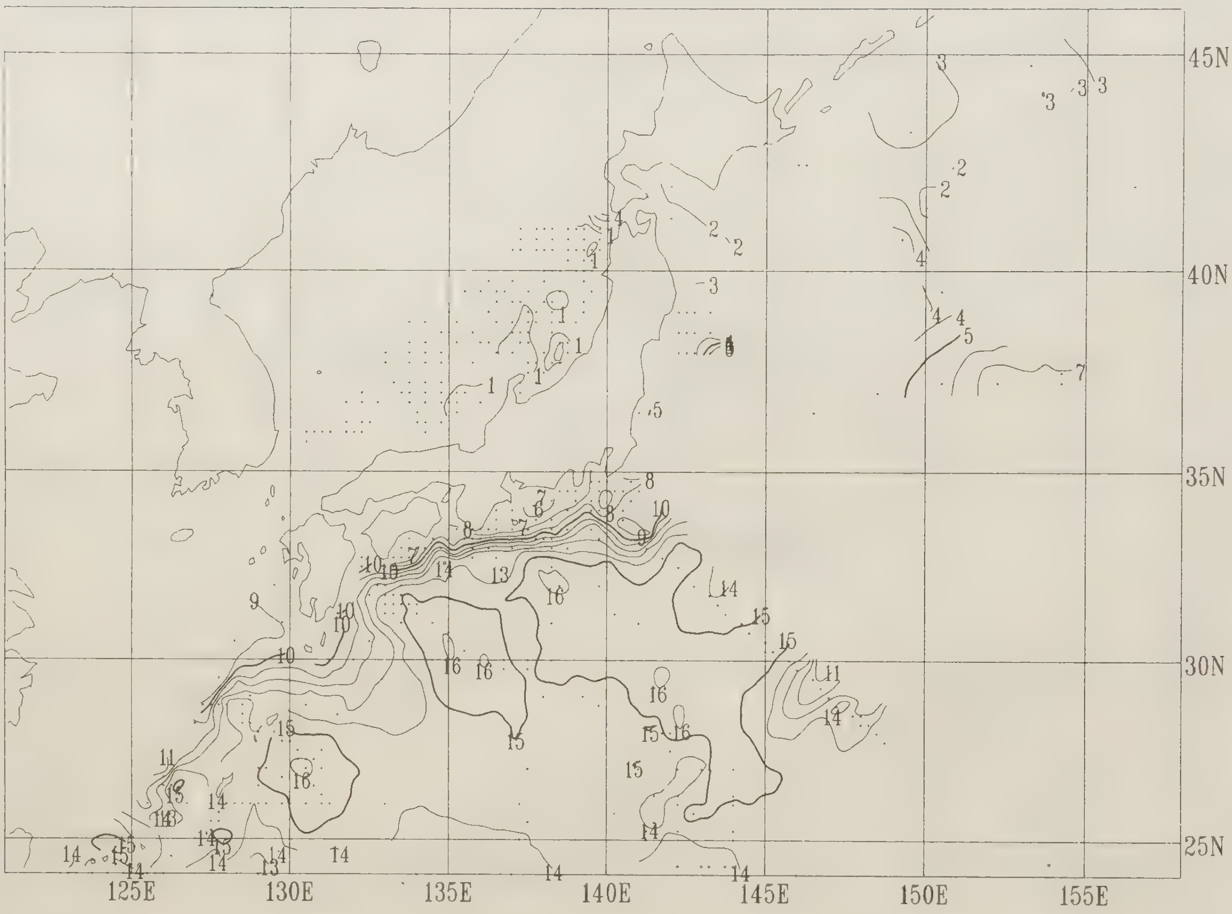
第5図　日本近海表層水温図(深さ100m) (1998年 3月)

Fig.5 Subsurface (100m) temperature in the seas adjacent to Japan for MAR 1998. Contour interval is 1°C. Observation points are denoted by dots.



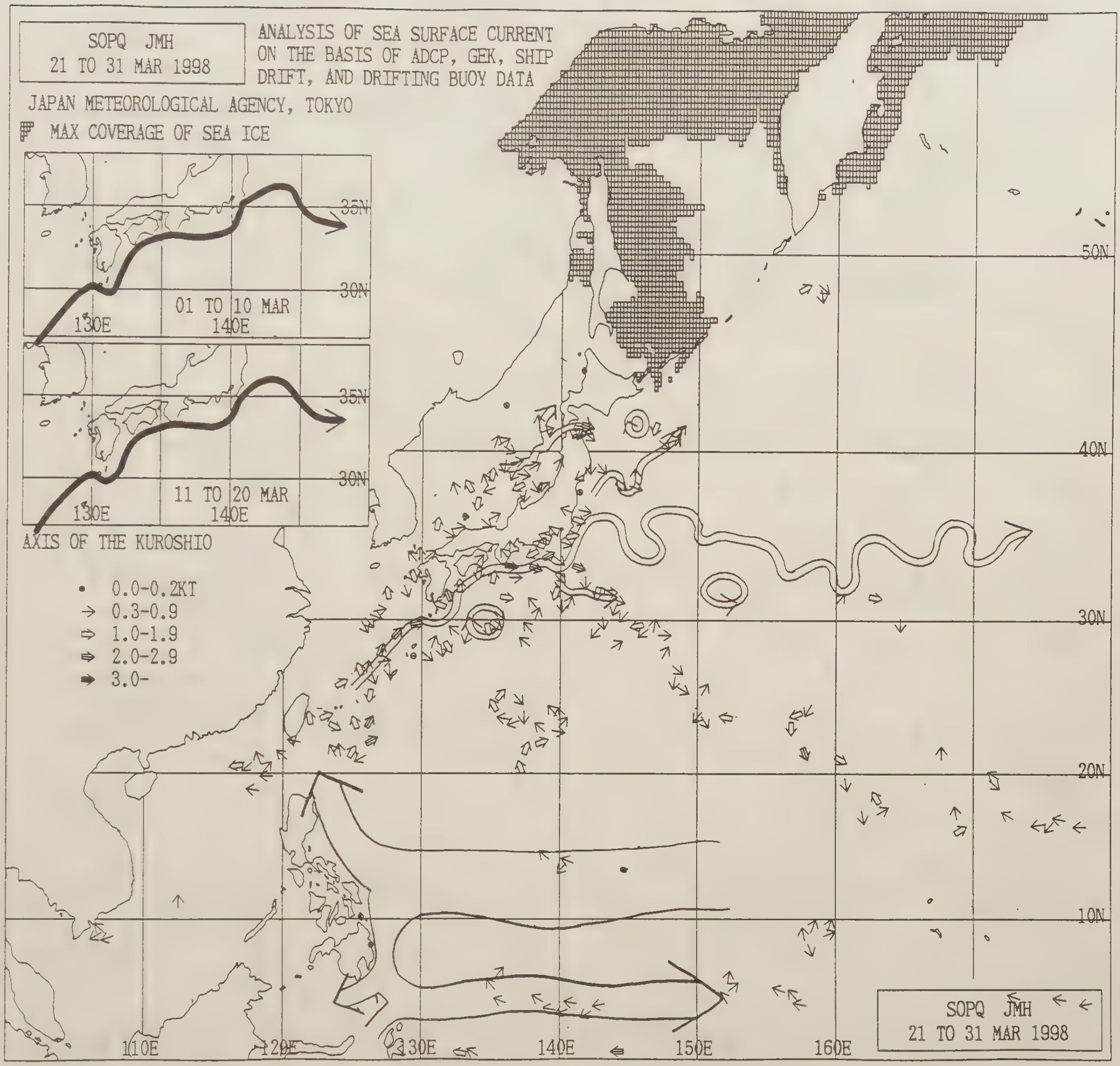
第6図　日本近海表層水温図(深さ200m)(1998年 3月)

Fig.6 Subsurface (200m) temperature in the seas adjacent to Japan for MAR 1998. Contour interval is 1°C. Observation points are denoted by dots.



第7図　日本近海表層水温図(深さ400m) (1998年 3月)

Fig.7 Subsurface (400m) temperature in the seas adjacent to Japan for MAR 1998. Contour interval is 1°C. Observation points are denoted by dots.



第8図　北西太平洋海流図（1998年 3月下旬）

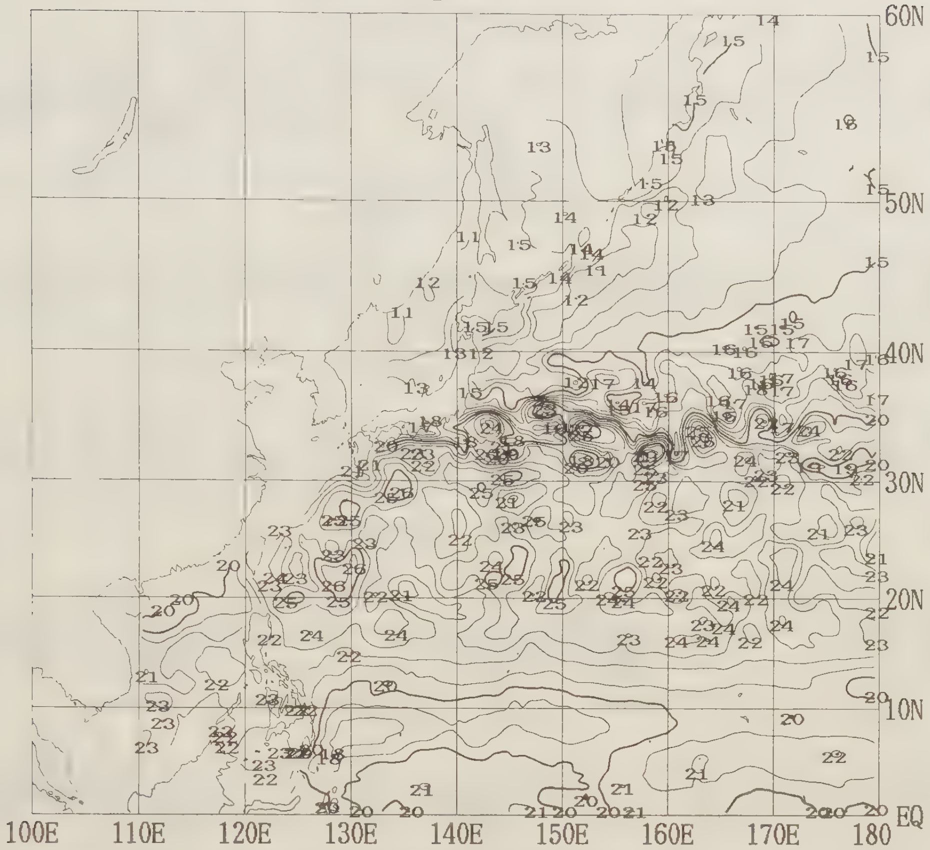
Fig.8 Analysis of the sea surface current in the western North Pacific for the 3rd ten-day period in MAR 1998. Small arrows indicate in situ observations. Major currents such as the Kuroshio and the North Equatorial Current are denoted by larger open arrows.



第9図 旬別黒潮流軸図

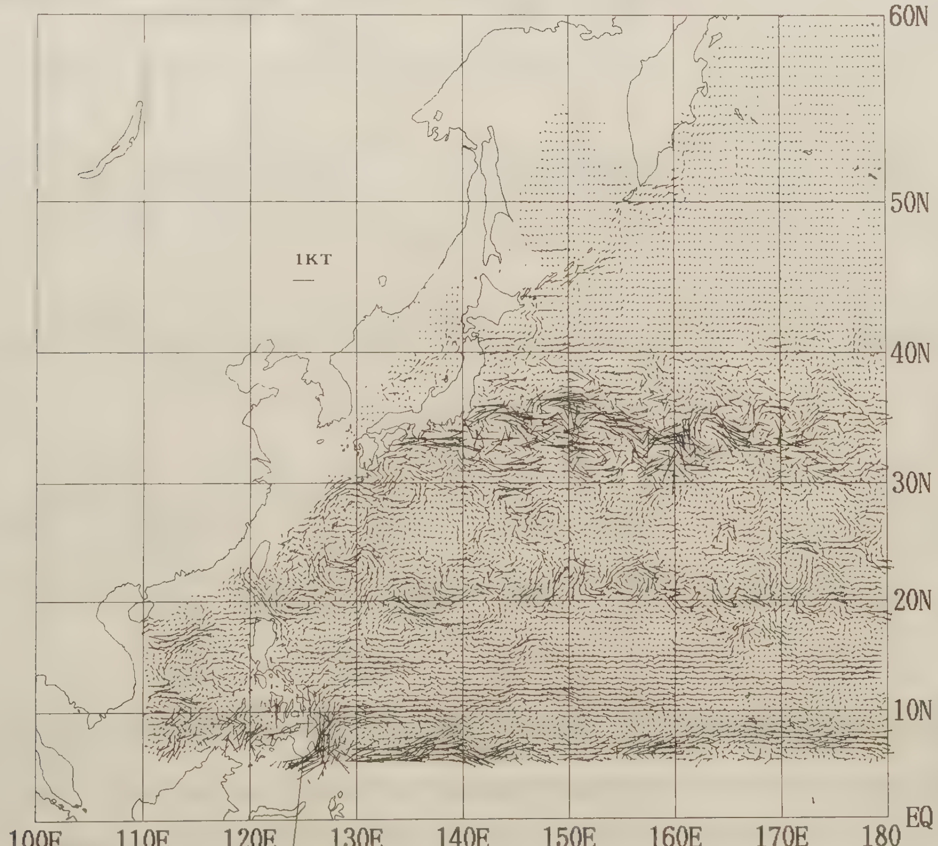
Fig.9 Location of the Kuroshio axis

Sea surface dynamic heights and current distribution



第10図 北西太平洋力学的海面高度分布図(1998年 3月14日)

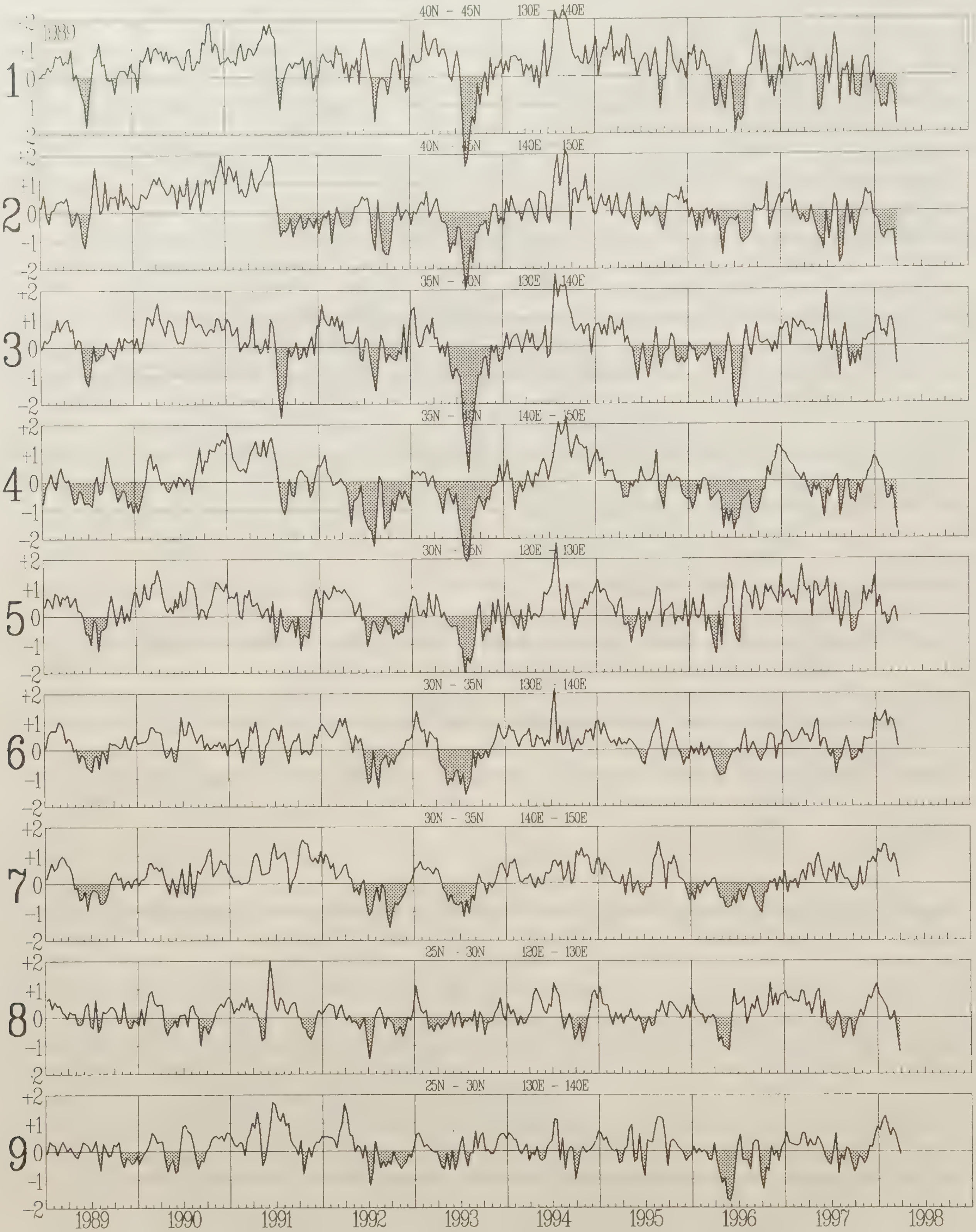
Fig.10 Sea surface dynamic heights (10cm) in the western North Pacific derived from the altimeter data of TOPEX/POSEIDON (MAR 14, 1998).
1500db surface is assumed to be the surface of no motion.



第11図 北西太平洋海流ベクトル図(1998年 3月14日)

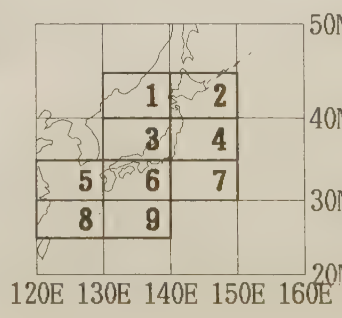
Fig.11 Sea surface current vectors in the western North Pacific (MAR 14, 1998).
Vectors are derived from the sea surface dynamic heights from TOPEX/POSEIDON and subsurface temperature distribution assuming the geostrophic relation.

Time Series of Area Mean SST in the Western North Pacific

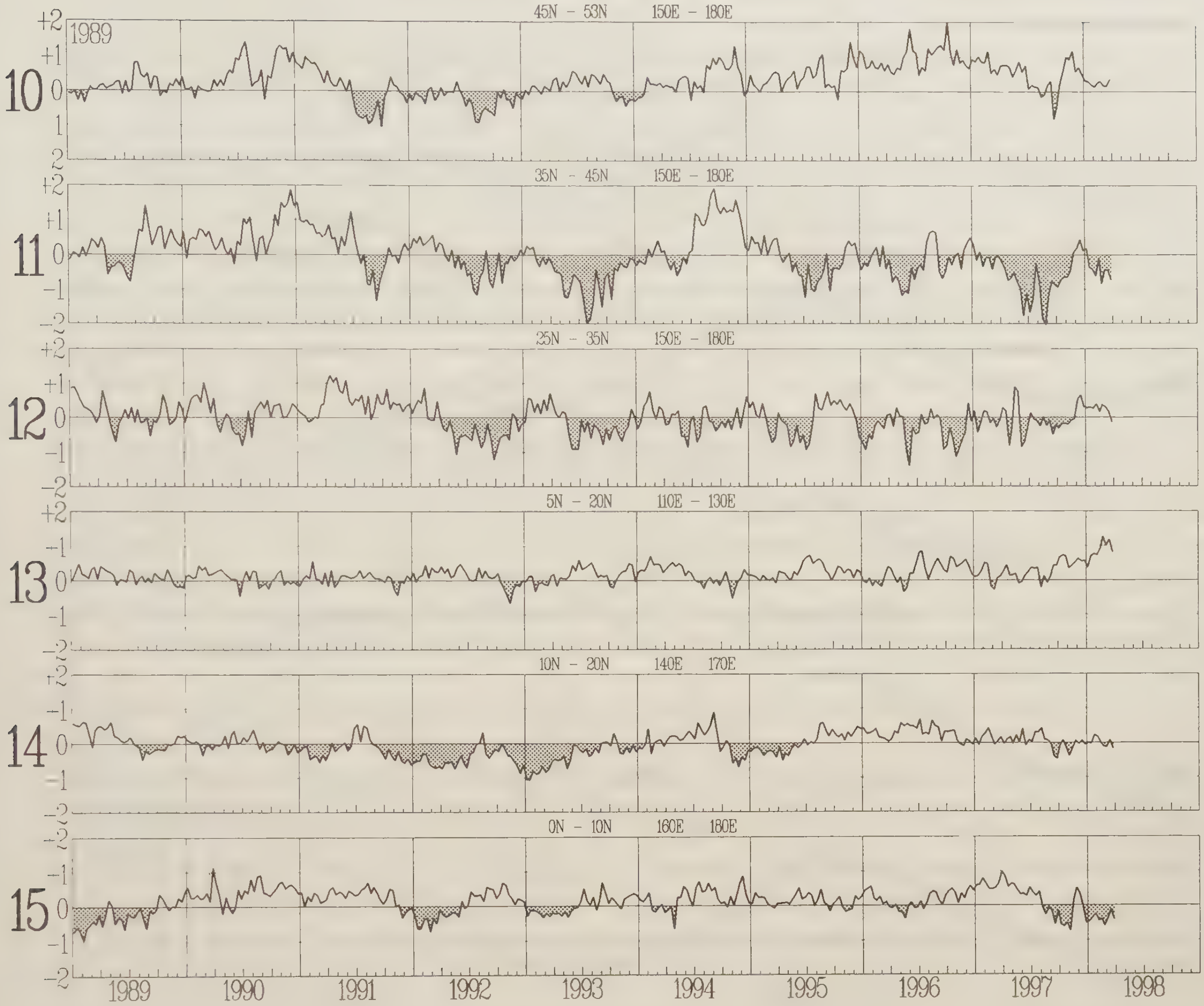


第12図　海域別旬平均海面水温平年偏差時系列図

Fig.12 Time series of the ten-day mean sea surface temperature anomalies (°C) in the western North Pacific for the areas shown in the right panel. Negative anomalies are shaded. Anomalies are computed from the JMA climatology (1961-90).

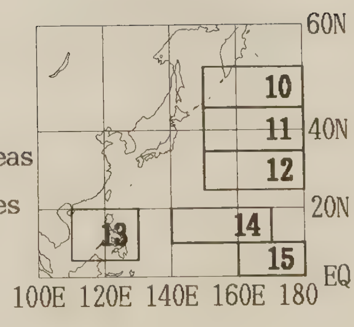


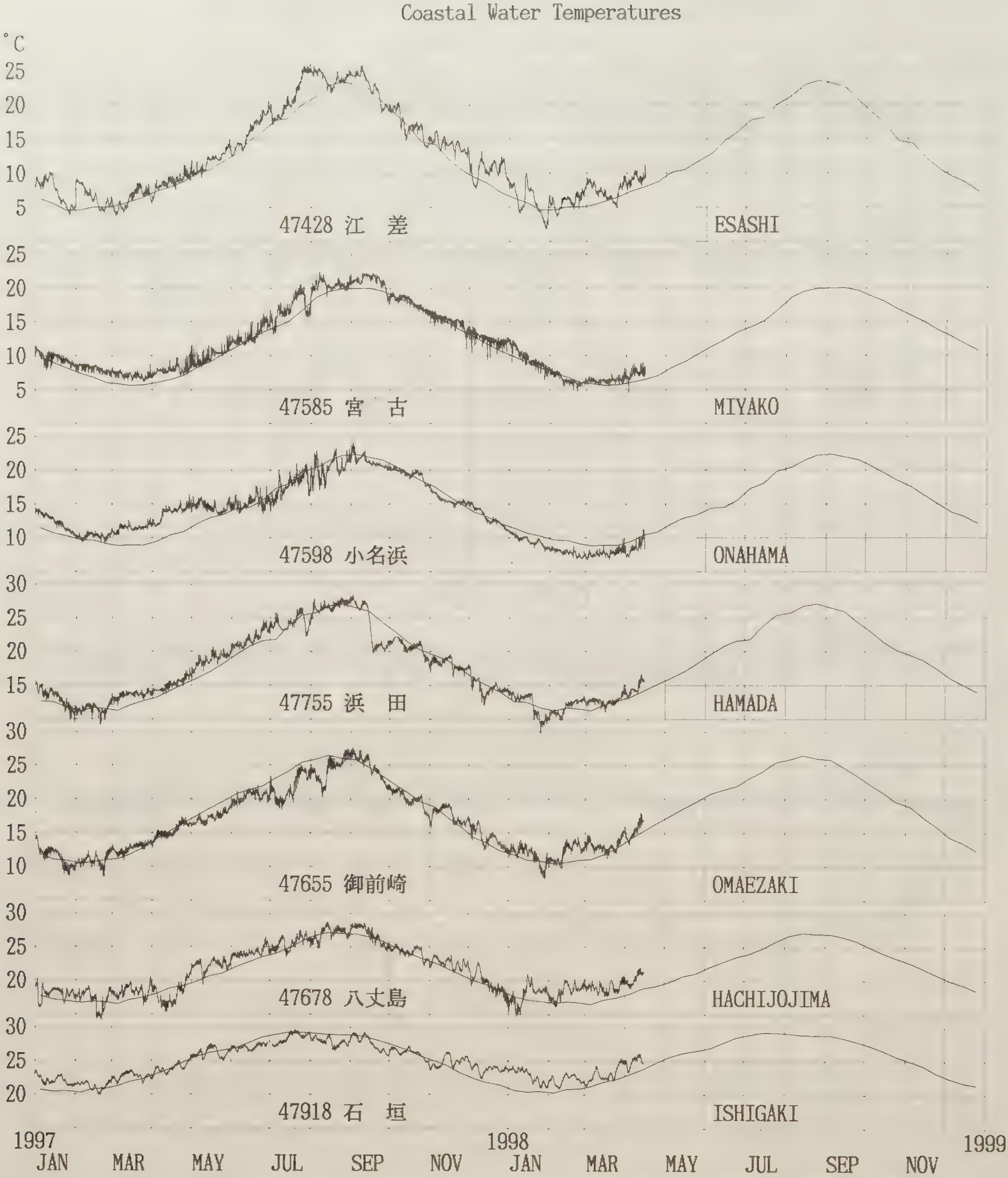
Time Series of Area Mean SST in the Western North Pacific

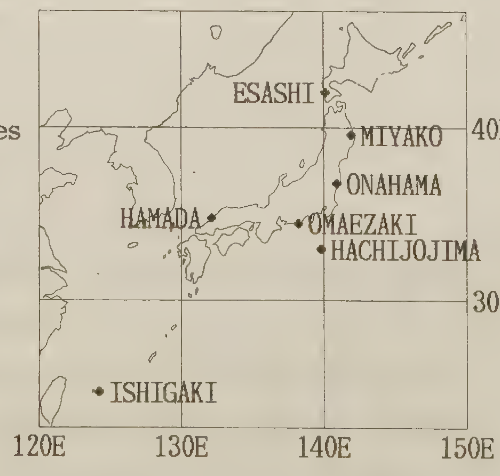


第12図　海域別旬平均海面水温平年偏差時系列図（つづき）

Fig.12 (continue) Time series of the ten-day mean sea surface temperature anomalies (°C) in the western North Pacific for the areas shown in the right panel. Negative anomalies are shaded. Anomalies are computed from the JMA climatology (1961-90).

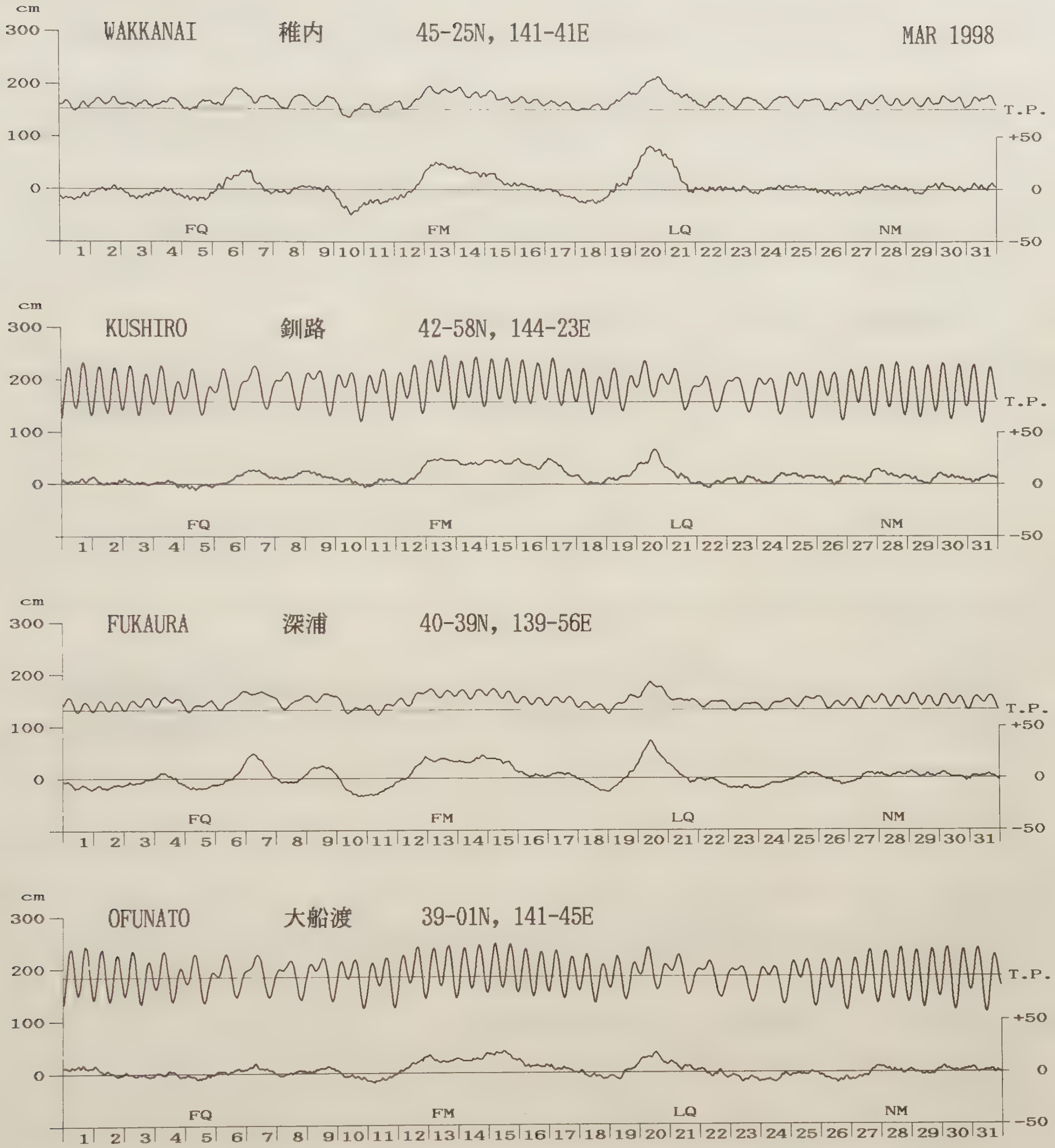






第13図 沿岸水温時系列図

Fig.13 Time series of hourly coastal water temperatures (°C) measured at 7 coastal stations of the JMA shown in the right panel.
Thin lines show ten-day mean climatology.



第14図 沿岸潮位時系列図（1998年 3月）

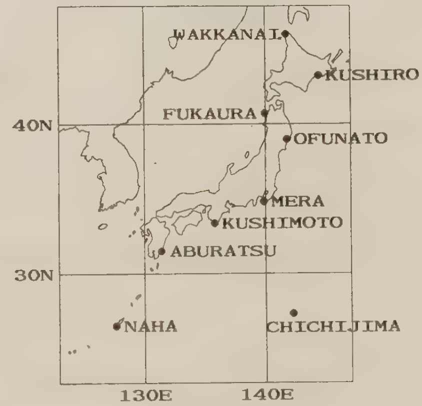
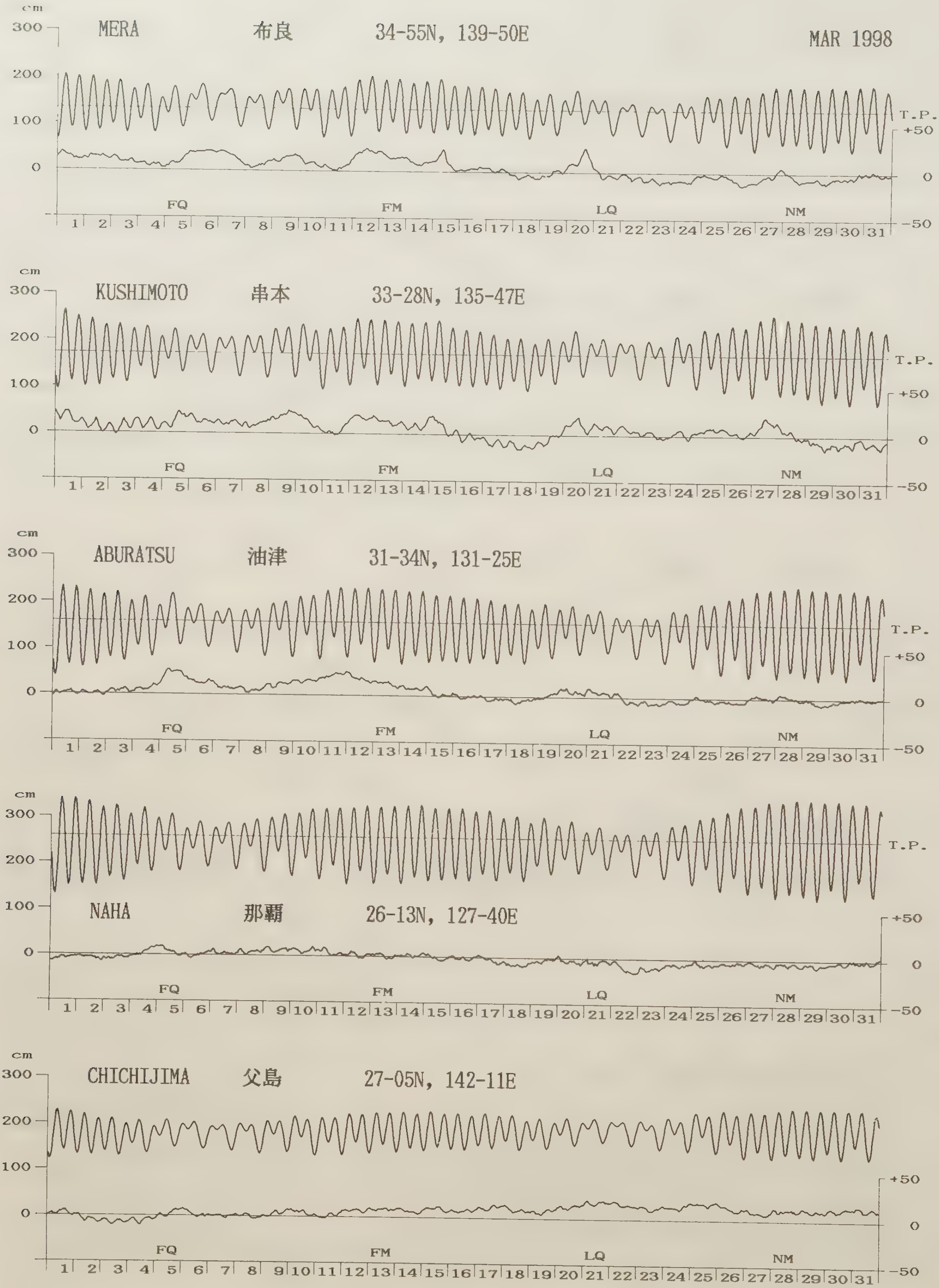
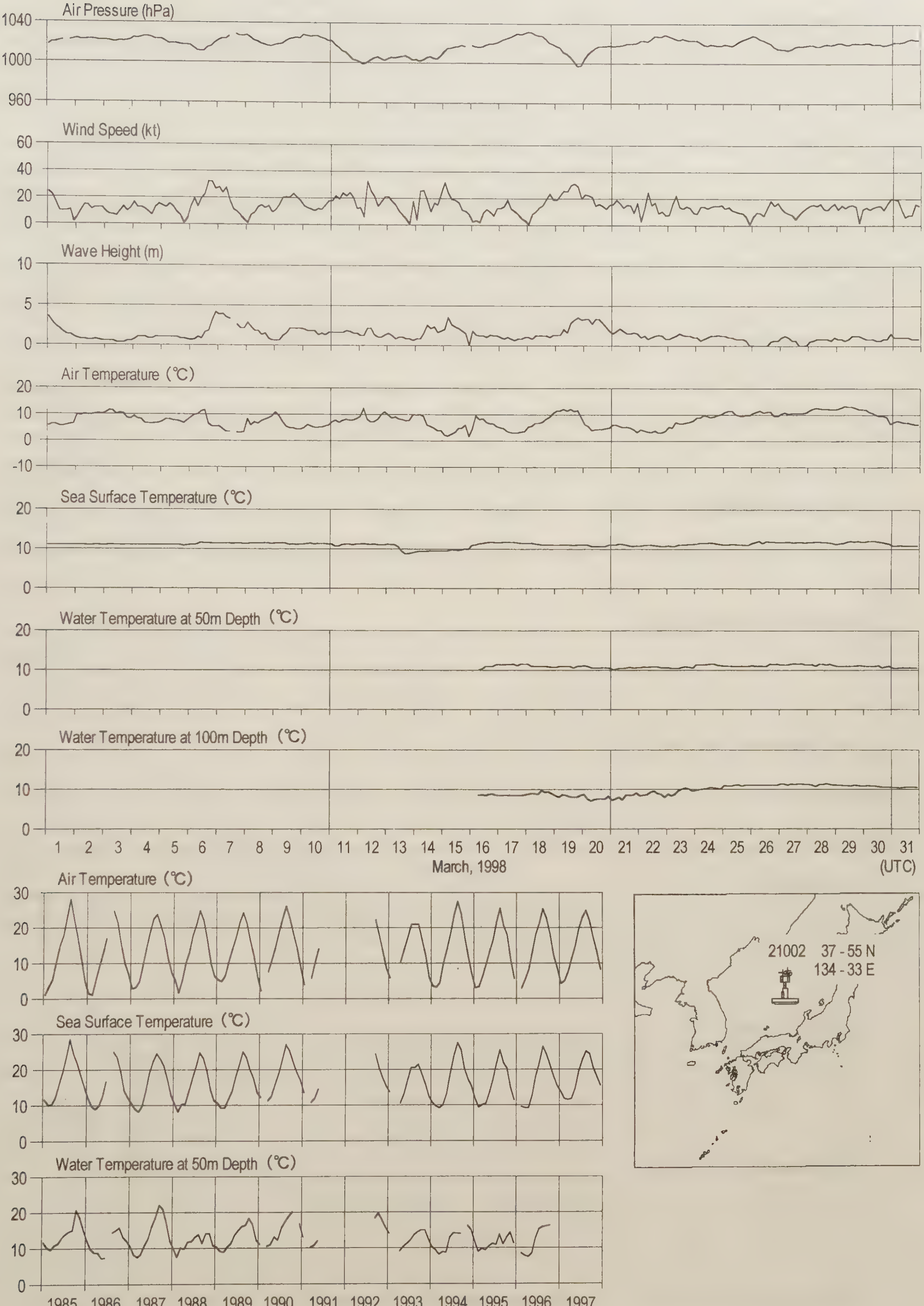


Fig.14 Time series of hourly sea level observation (upper line) and its anomalies (lower line) at 9 stations of the JMA in the right panel.
Short term variations are removed from raw data.

FM: full moon, FQ: first quarter
NM: new moon, LQ: last quarter
T.P.: Mean sea level of Tokyo Bay (Tokyo Peil)

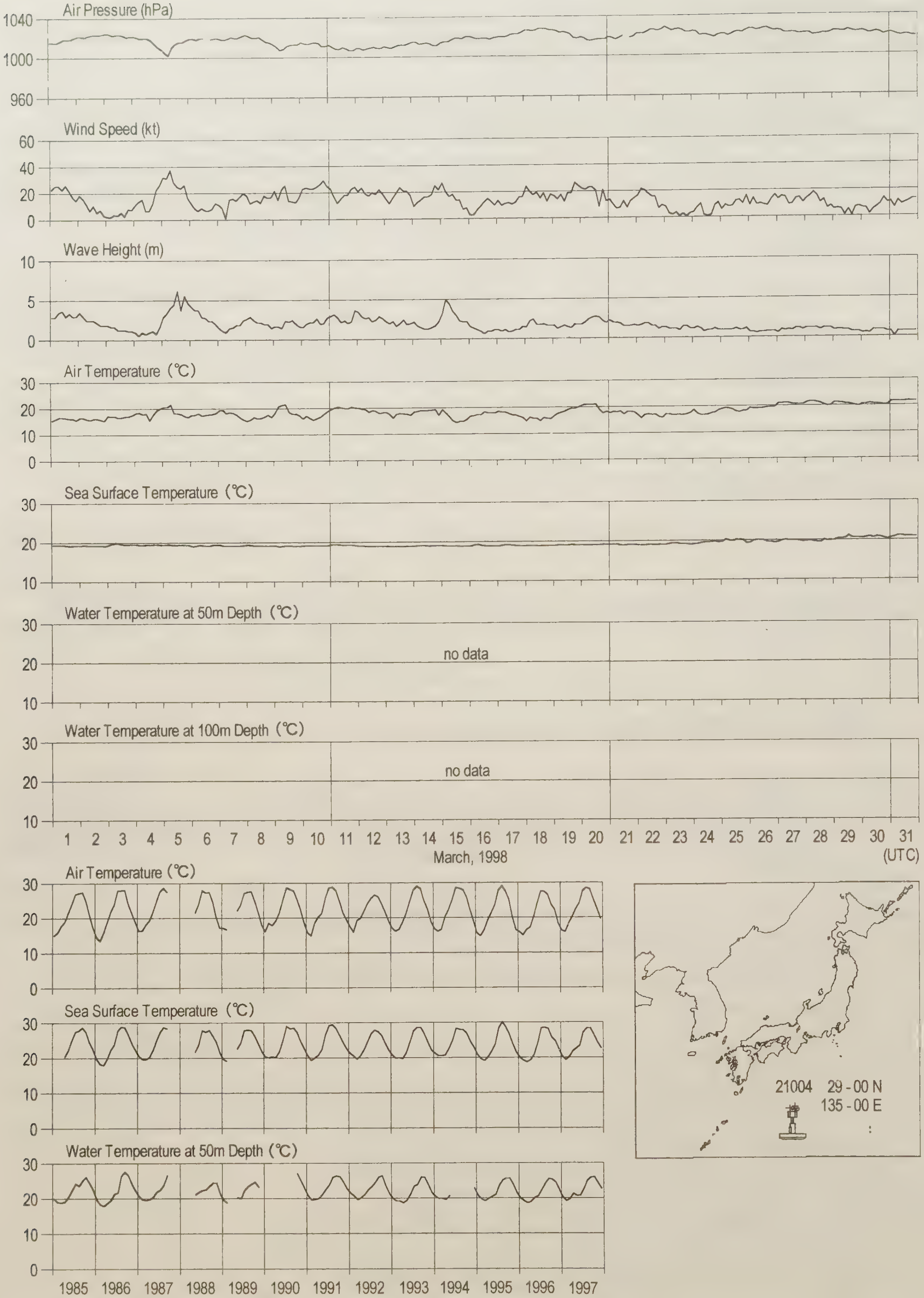


第14図 つづき
Fig.14 continue



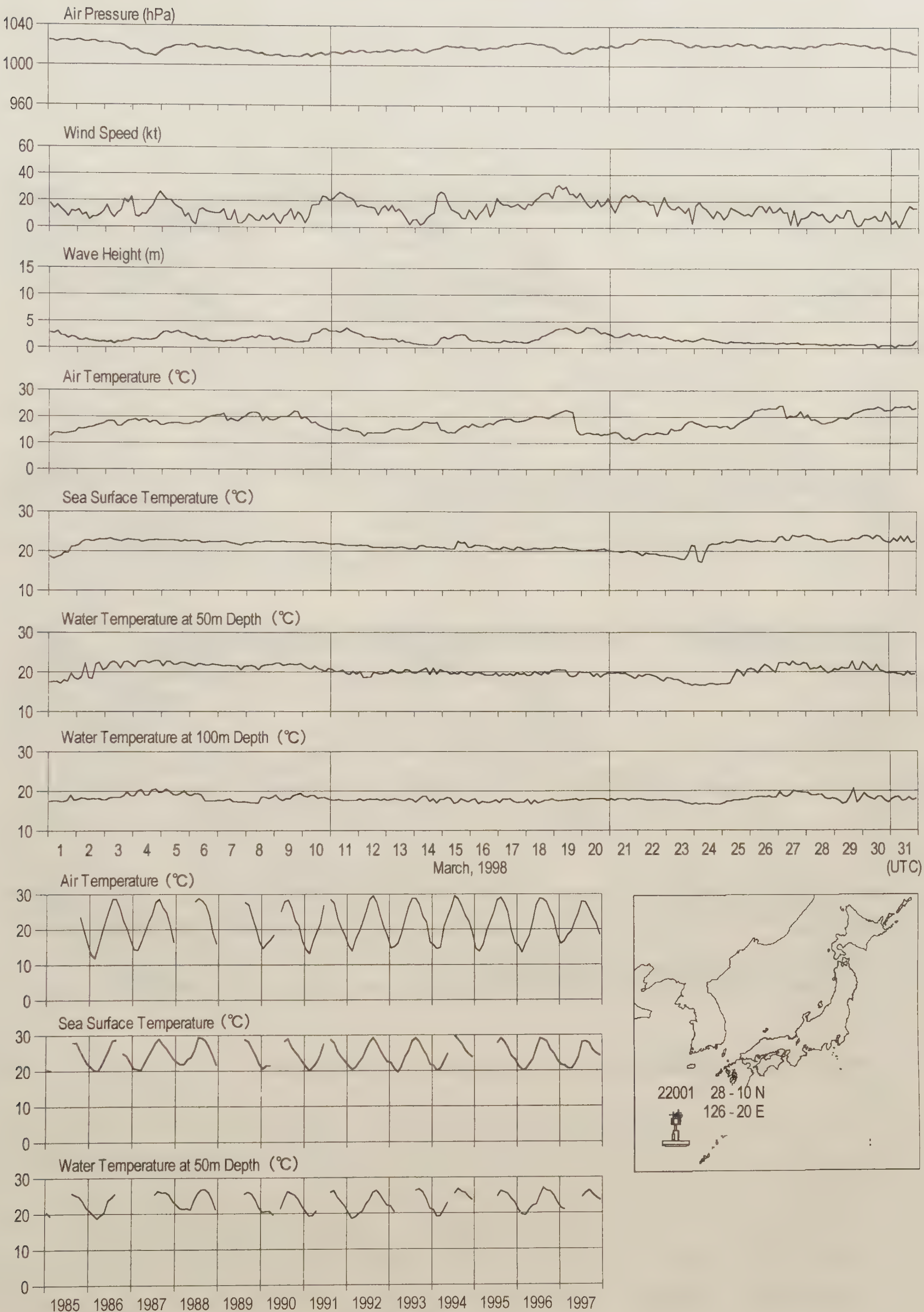
第15図　海洋気象ブイロボットによる観測要素の時系列図（日本海：21002）
上段は３時間毎の観測値を、下段は月平均値を示す。

Fig. 15　Time series of JMA buoy observation in the Japan Sea (WMO ID No. 21002). The upper panel shows three hourly observation and the lower panel shows the monthly mean data.



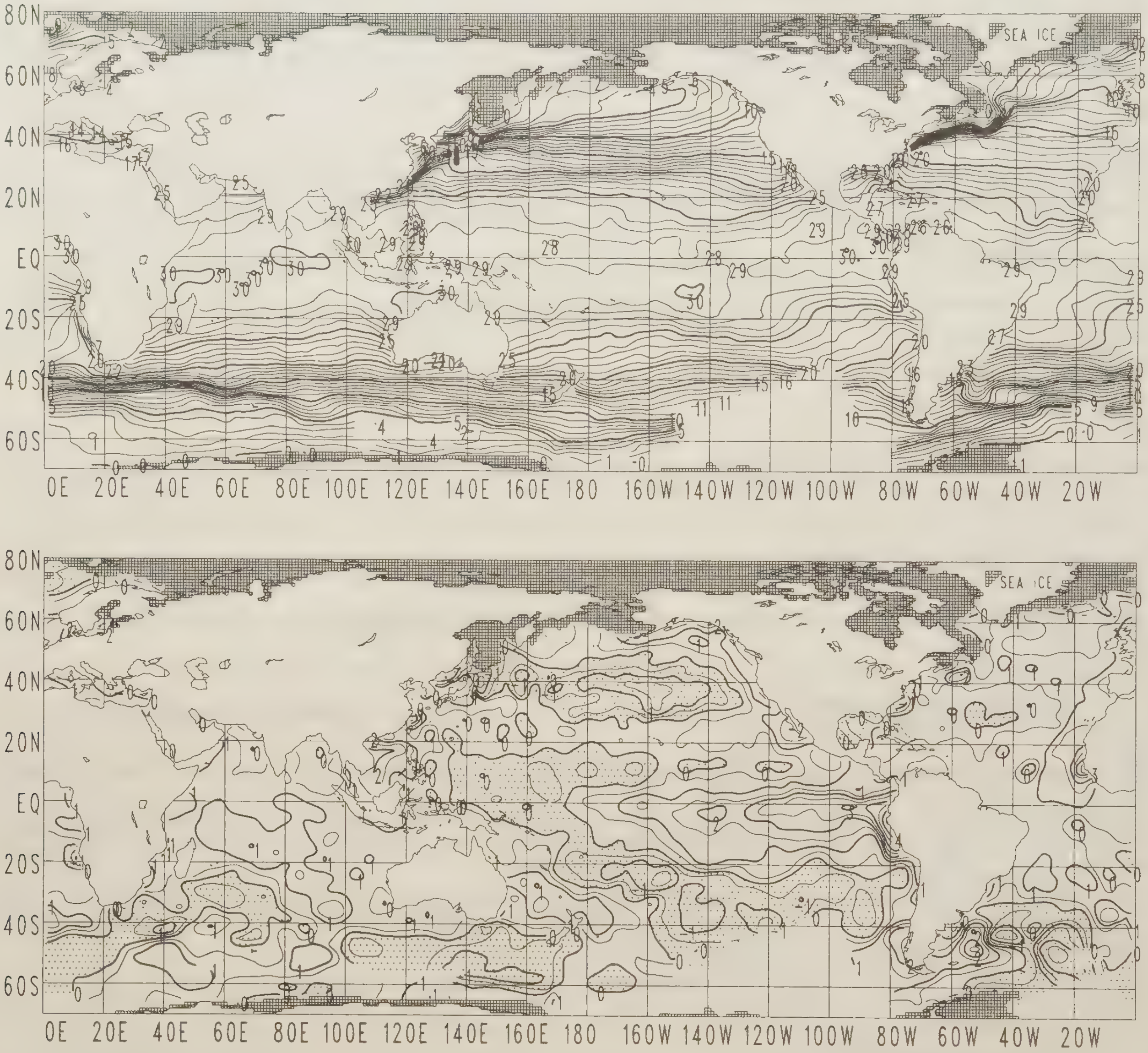
第15図　海洋気象ブイロボットによる観測要素の時系列図（四国沖：21004）
上段は３時間毎の観測値を、下段は月平均値を示す。

Fig. 15　Time series of JMA buoy observation south of Shikoku (WMO ID No. 21004). The upper panel shows three hourly observation and the lower panel shows the monthly mean data.



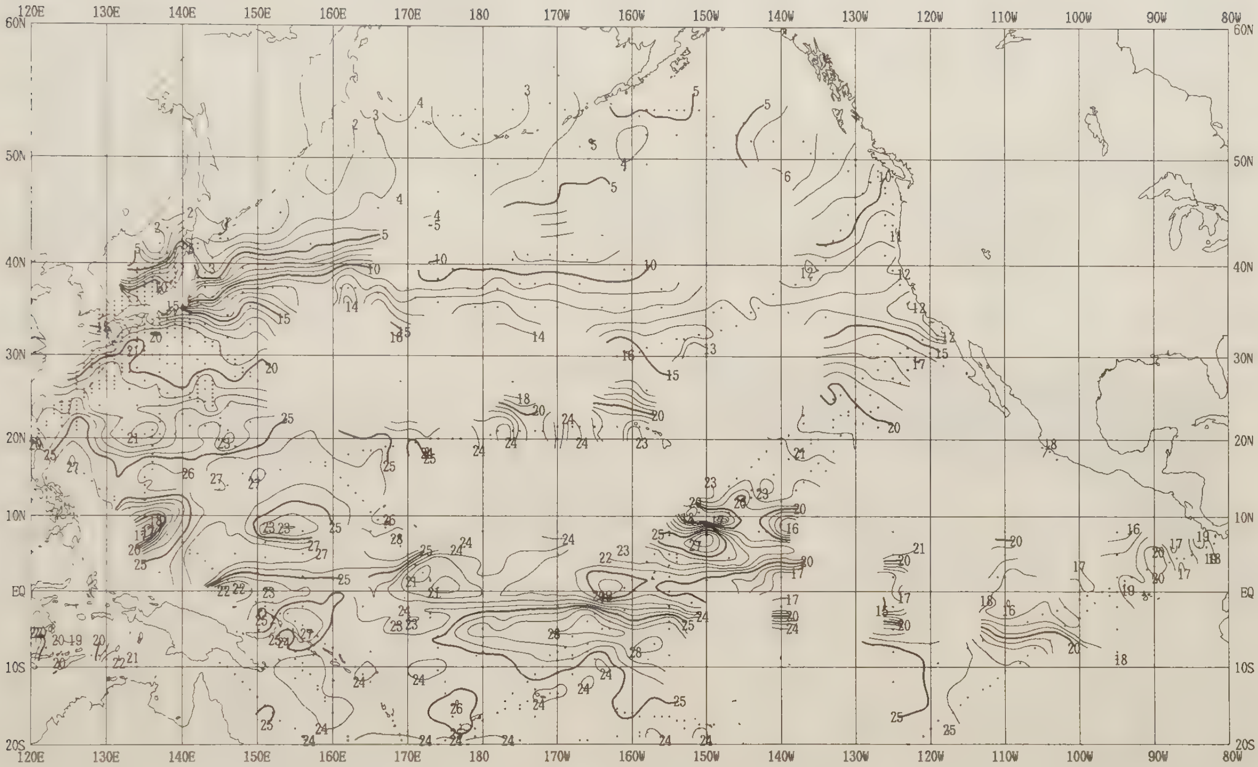
第15図　海洋気象ブイロボットによる観測要素の時系列図（東シナ海：22001）
上段は３時間毎の観測値を、下段は月平均値を示す。

Fig. 15　Time series of JMA buoy observation in the East China Sea (WMO ID No. 22001). The upper panel shows three hourly observation and the lower panel shows the monthly mean data.



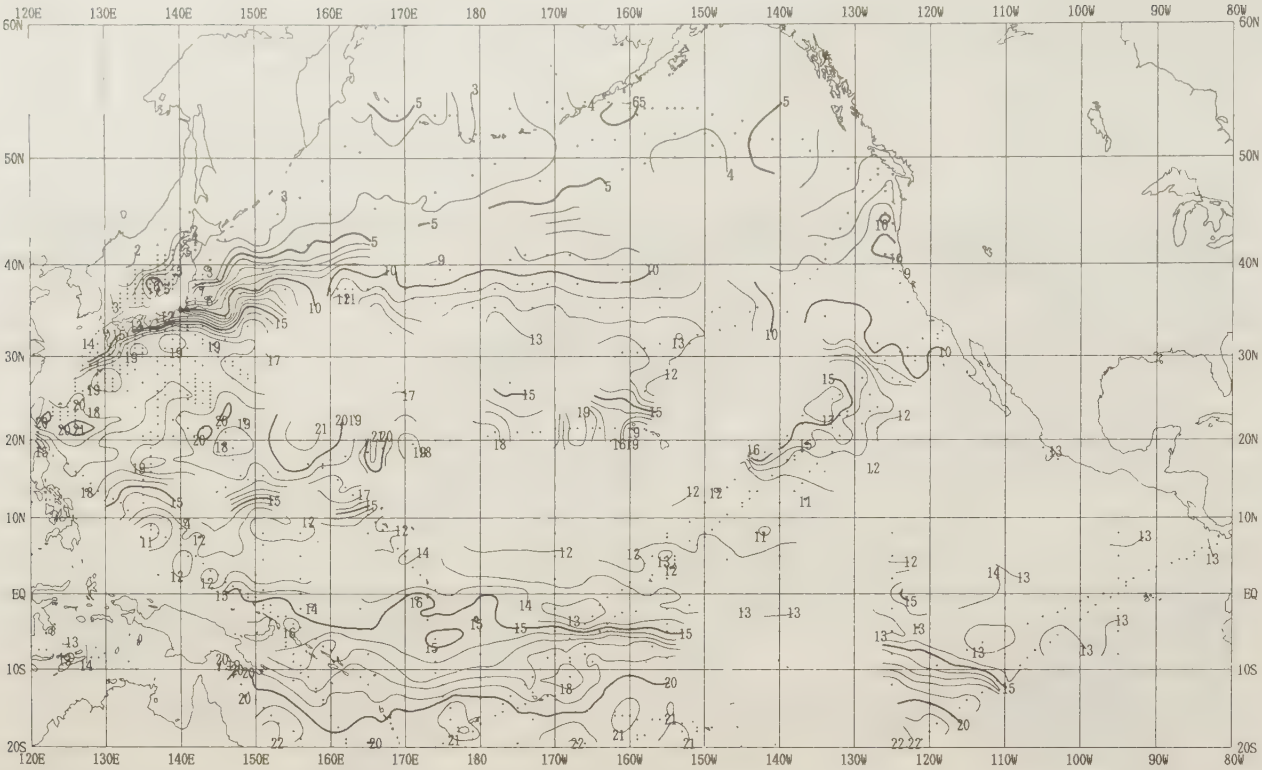
第16図　全球月平均海面水温図（上）及び偏差図（下）（1998年 3月）

Fig.16 Monthly mean sea surface temperature over the global ocean (top) and anomalies (bottom) for MAR 1998. Anomalies are computed from the JMA climatology (1961-1990). Contour interval is 1°C (top) and additional anomaly contours of ±0.5°C are shown by thin lines. Negative anomalies are spotted. Maximum coverage of sea ice is shaded. Data sources for sea ice are U.S. National Ice Center (polar regions) and JMA (the Sea of Okhotsk).



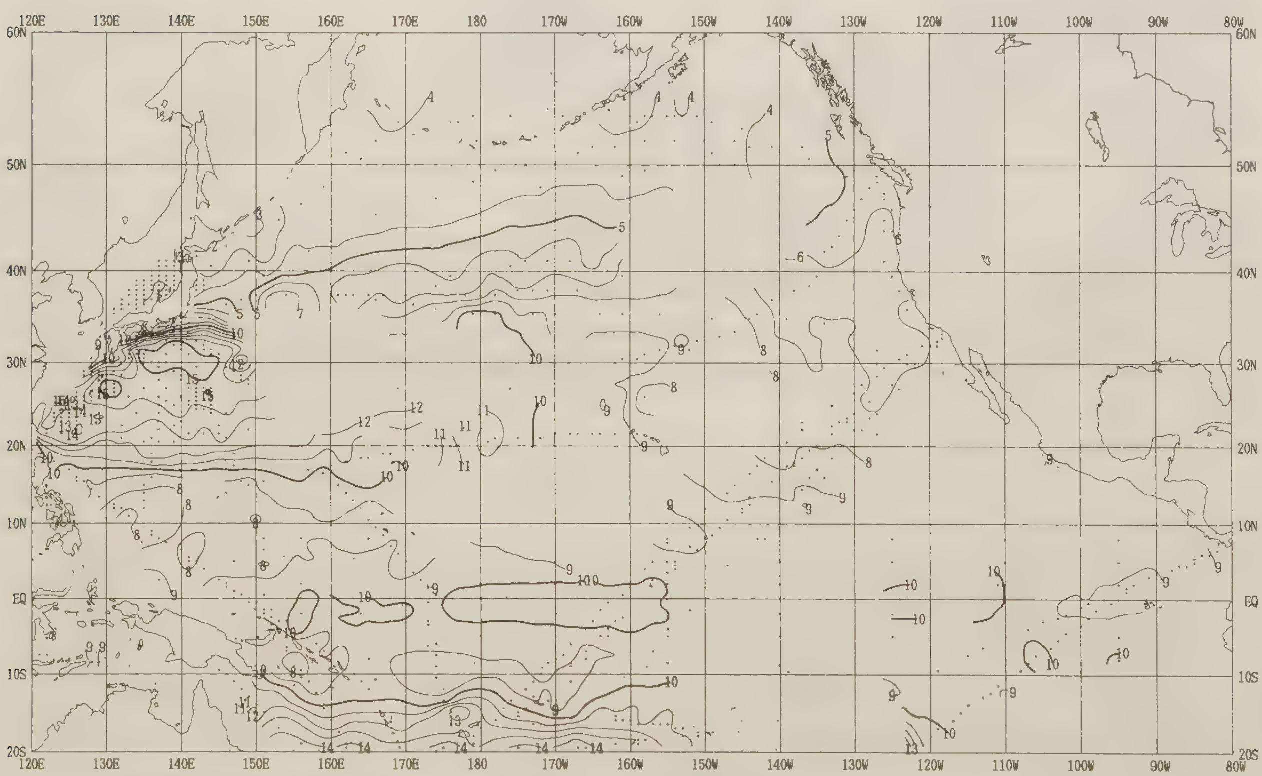
第17図　太平洋表層水温図(深さ100m) (1998年 3月)

Fig.17 Subsurface (100m) temperature in the Pacific Ocean for MAR 1998. Contour interval is 1°C. Observation points are denoted by dots.



第18図　太平洋表層水温図(深さ200m) (1998年 3月)

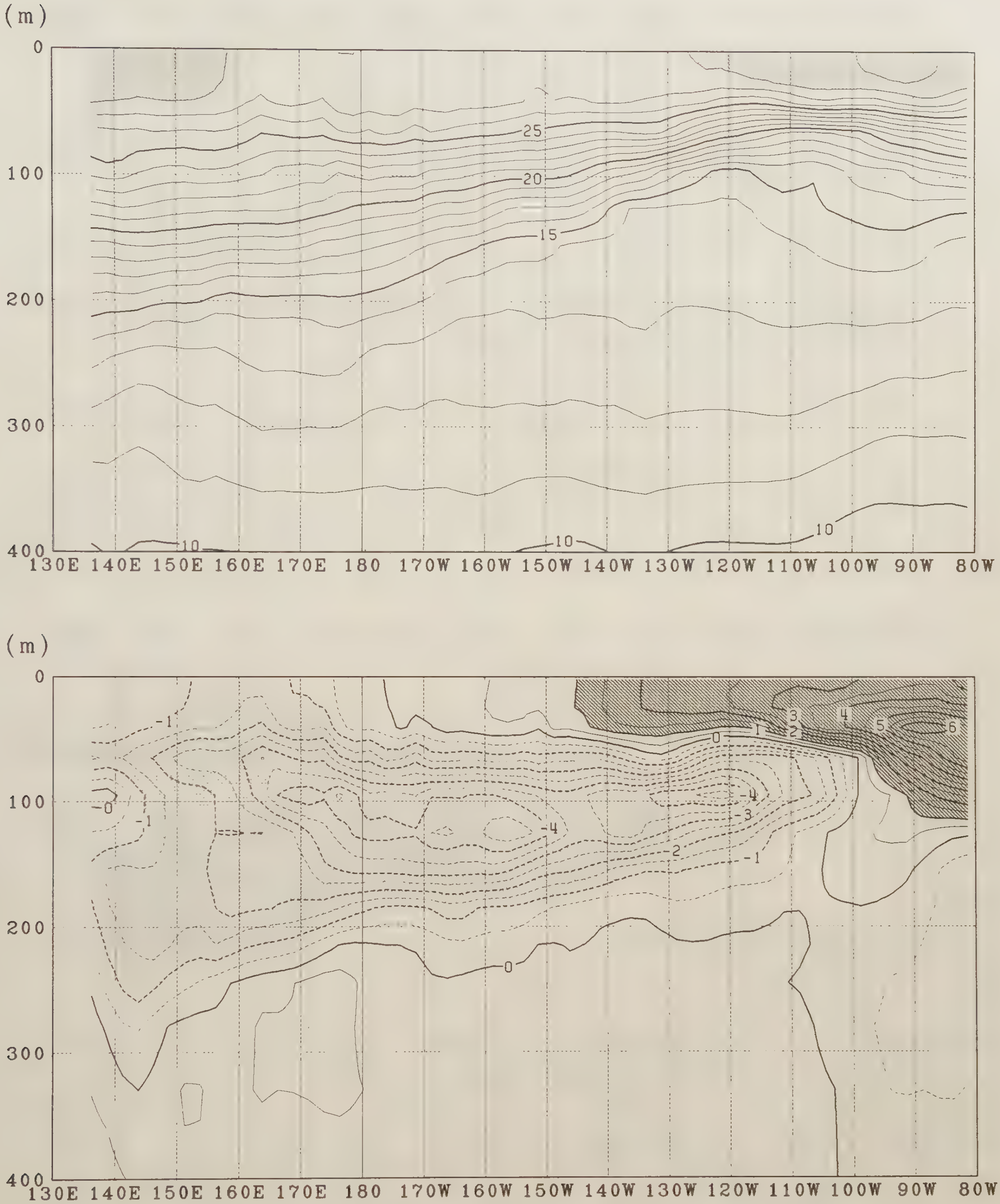
Fig.18 Subsurface (200m) temperature in the Pacific Ocean for MAR 1998.
Contour interval is 1°C. Observation points are denoted by dots.



第19図　太平洋表層水温図(深さ400m) (1998年 3月)

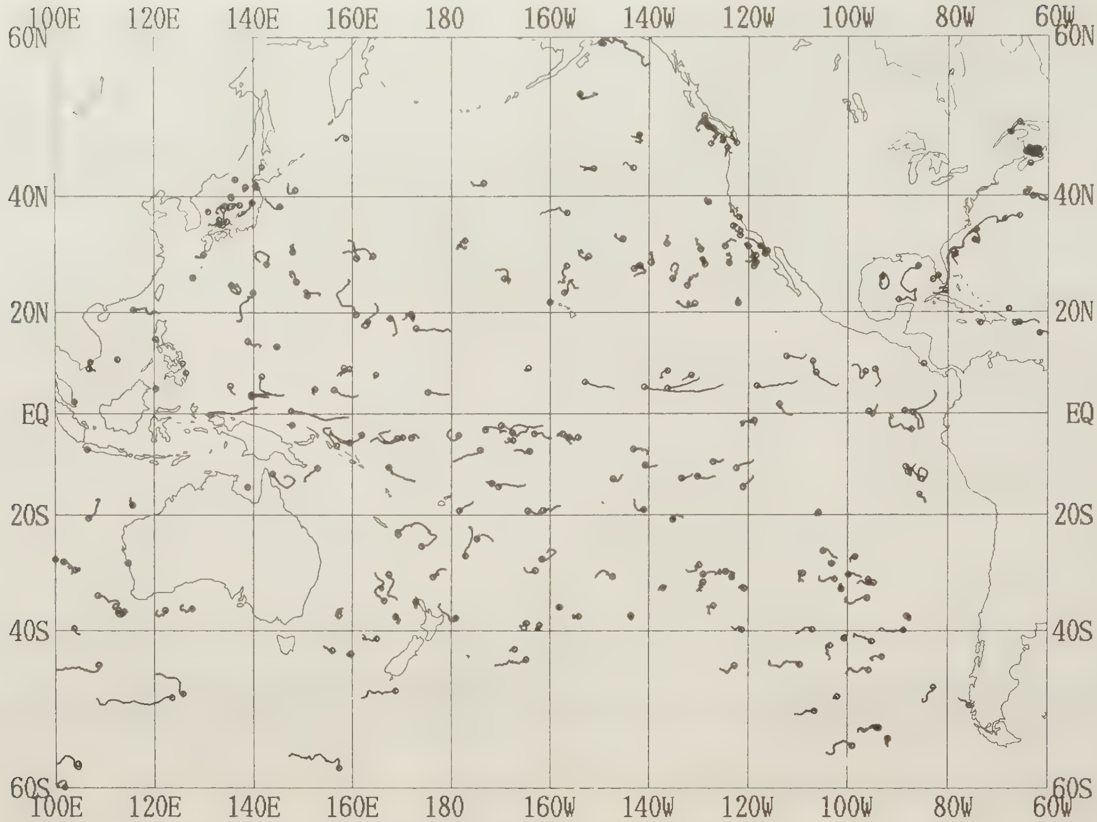
Fig.19 Subsurface (400m) temperature in the Pacific Ocean for MAR 1998.
Contour interval is 1°C. Observation points are denoted by dots.

Depth-Longitude Sections of Equatorial Temperature & Anomalies



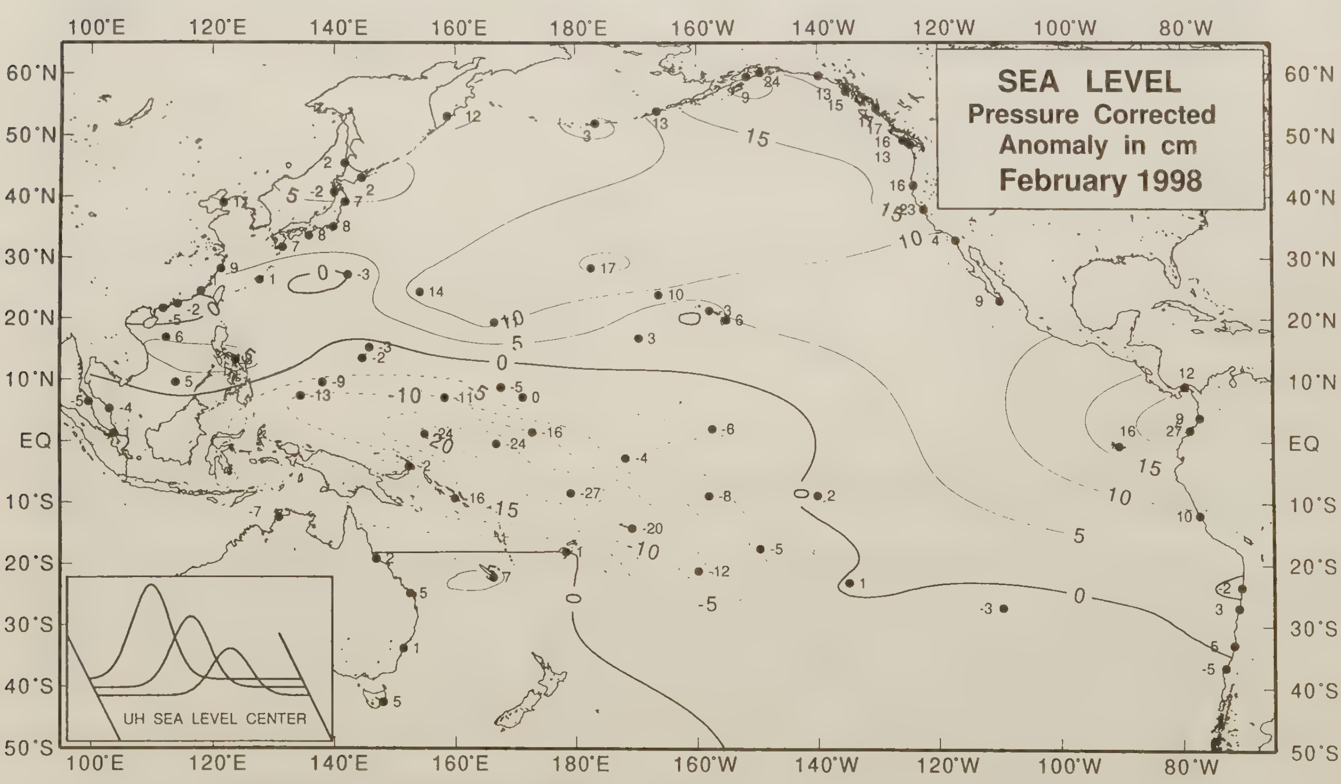
第20図　太平洋赤道に沿う表層水温（上）及び偏差（下）の深度－経度断面図（1998年 3月）

Fig.20 Depth-longitude sections of temperature (top) and anomalies (bottom) along the equator in the Pacific Ocean for MAR 1998. Data are derived from the Ocean Data Assimilation System of JMA. Contour interval is 1°C (top) and 0.5°C (bottom). Values greater than 28°C in the top panel are shaded. In the bottom panel, values greater than 1°C are shaded and values less than -1°C are spotted. Anomalies are computed from 1987-1996 base period means.



第21図　太平洋ブイ流跡図(1998年 3月)

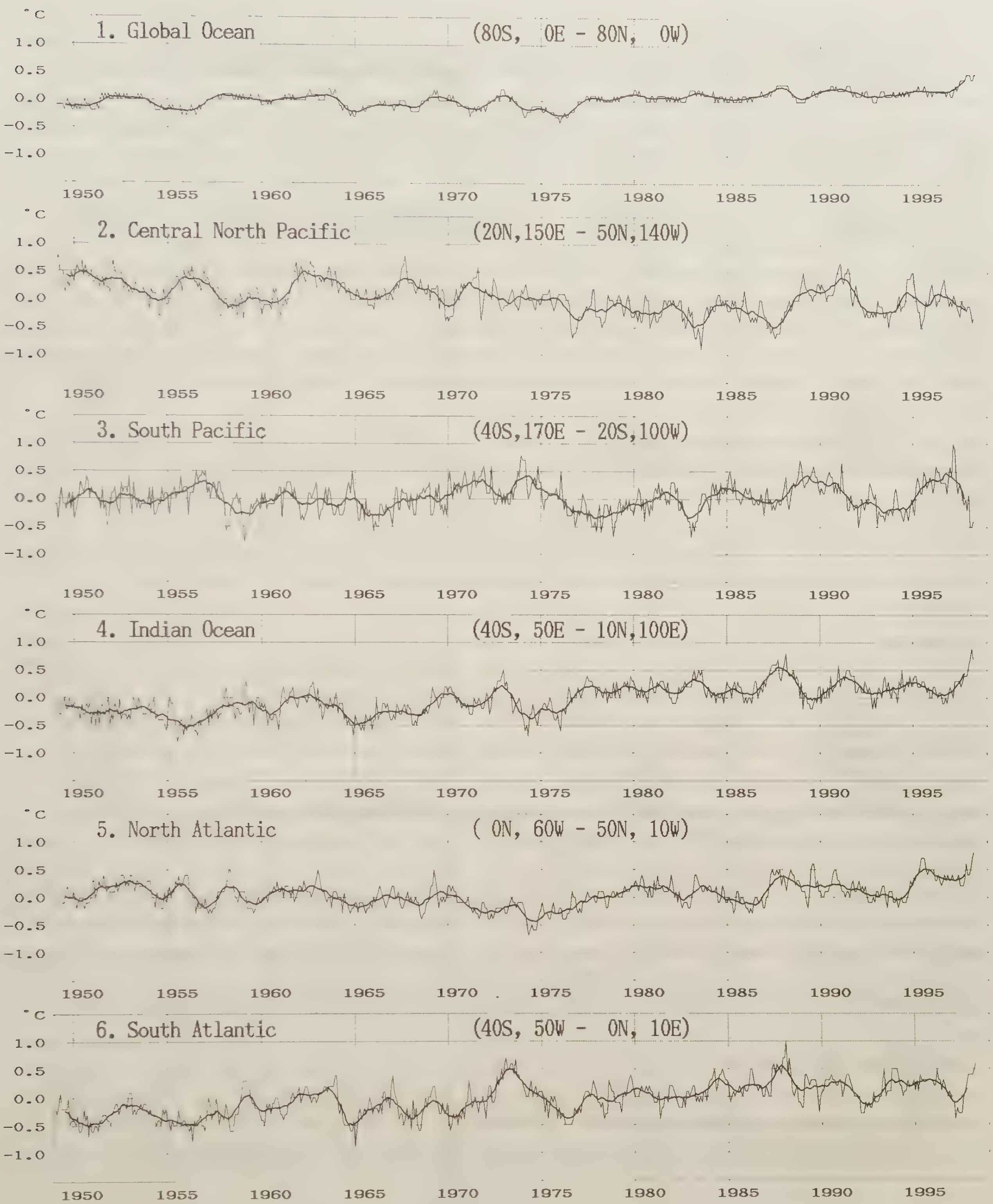
Fig.21 Movements of drifting buoys in the Pacific Ocean during MAR 1998. Each track is for one buoy. Small circles represent last positions for the month.



第22図　太平洋海面水位偏差図 (1998年 2月)

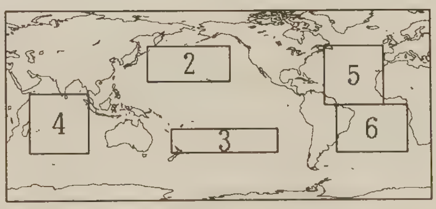
Fig.22 Monthly sea level anomalies for FEB 1998 obtained from mean sea level (1975-1995) adjusted for atmospheric pressure. This figure is prepared by the SOC of ISLP-PAC, Dept. of Oceanography, Univ. of Hawaii.

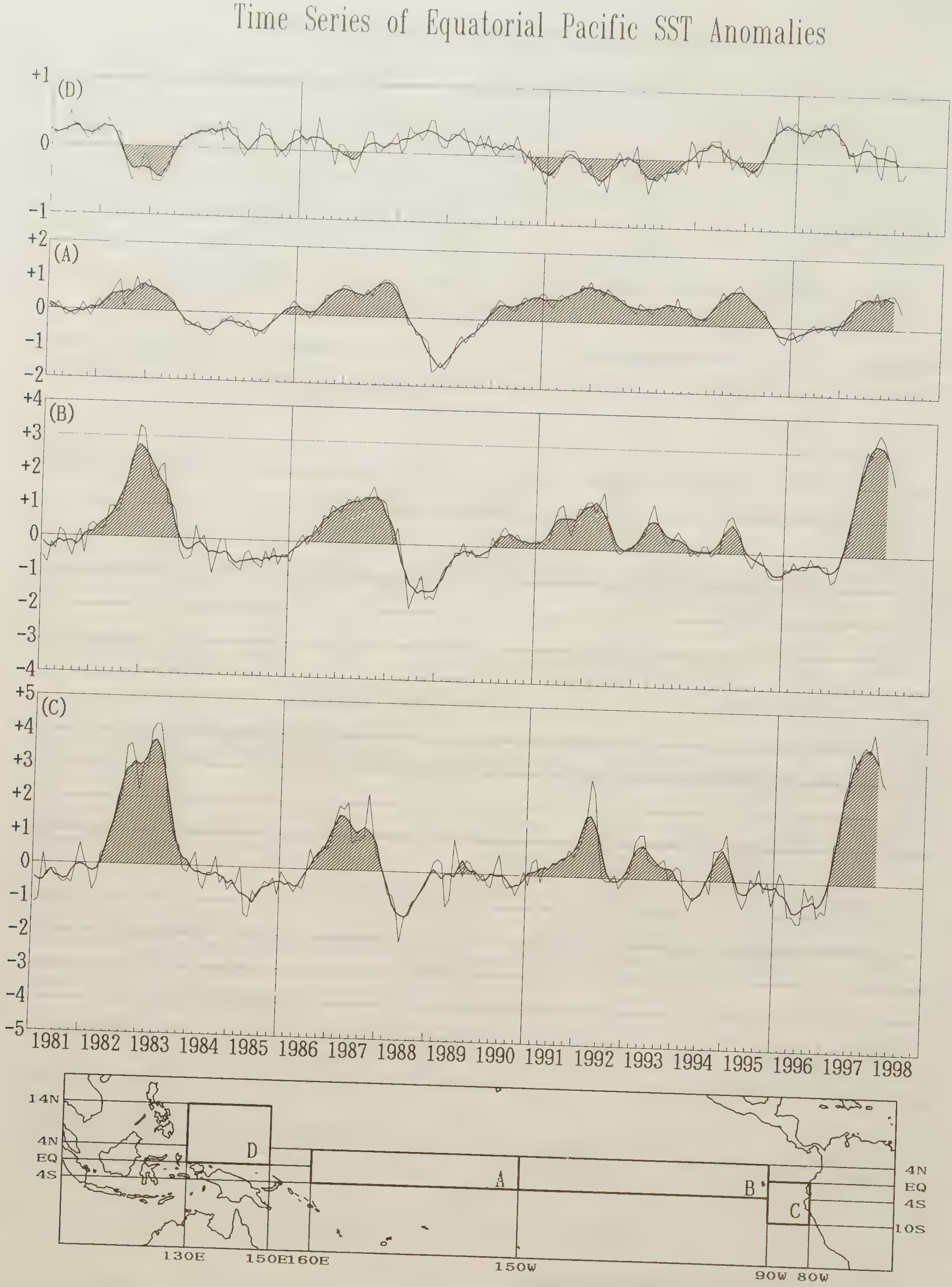
Long-term Variation of Monthly Mean SST Anomalies



第23図 海域平均海面水温偏差の長期変動

Fig.23 Long-term variations of monthly mean sea surface temperature anomalies (°C) for the areas shown in the right panel. Anomalies are computed from the JMA climatology (1961-90). Thin lines show the monthly mean and thick lines their 13-month running means.





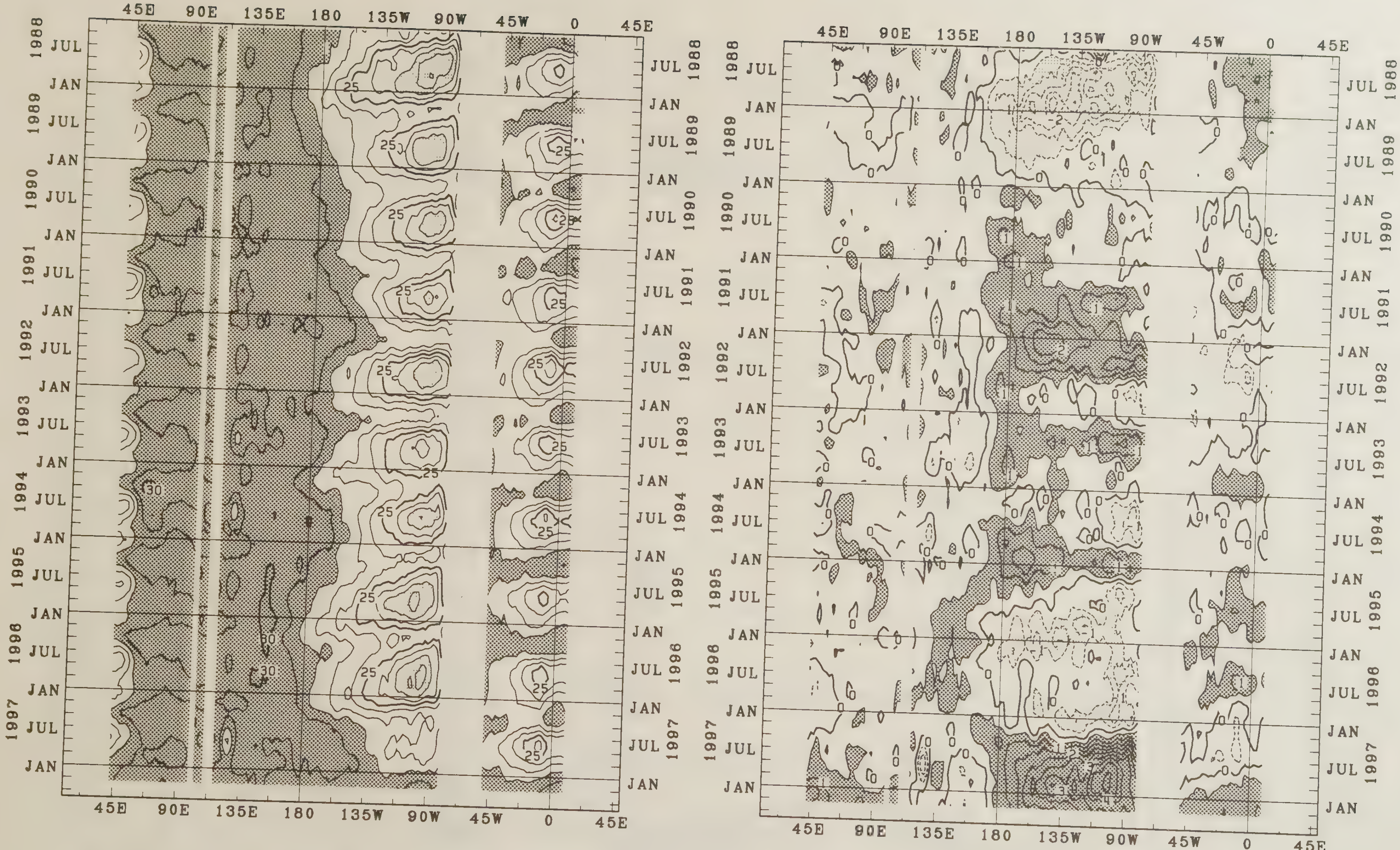
第24図　太平洋赤道域の海面水温偏差時系列図

Fig.24 Time series of monthly mean SST anomalies (°C) in the equatorial Pacific Ocean for the areas indicated at the bottom panel. Thin lines show the monthly means and thick lines their 5-month running means. Positive anomalies (A, B, C) and negative anomalies (D) are shaded. Anomalies are computed from the JMA climatology (1961-1990).

MONTH	SEA SURFACE TEMPERATURE AND ANOMALY (°C) REGION D 14N-EQ 130E-150E		REGION A 4N-4S 160E-150W		REGION B 4N-4S 150W-90W		REGION C EQ-10S 90W-80W		SOI	SEA LEVEL PRESSURE ANOMALY (hPa) TAHITI 17-33S 149-37W	DARWIN 12-24S 130-52E
JAN 96	29.0	0.5	27.9	-0.1	25.0	-0.4	24.1	-0.2	0.8	1.0	-0.7
FEB 96	28.6	0.3	27.6	-0.4	25.7	-0.5	26.0	0.3	0.1	-0.2	-0.5
MAR 96	28.8	0.4	27.8	-0.3	26.7	-0.2	25.9	0.0	0.7	1.0	-0.3
APR 96	29.3	0.5	28.1	-0.1	26.7	-0.4	24.1	-1.0	0.8	0.5	-0.5
MAY 96	29.6	0.5	28.5	0.0	26.2	-0.4	22.9	-1.0	0.3	1.2	1.2
JUN 96	29.7	0.4	28.6	0.1	25.7	-0.4	21.5	-1.2	1.4	1.6	-0.2
JUL 96	29.8	0.6	28.4	-0.1	25.1	-0.1	20.4	-1.2	0.7	0.6	-0.6
AUG 96	29.6	0.5	28.4	0.0	24.3	-0.3	20.5	-0.1	0.4	0.4	-0.3
SEP 96	29.8	0.6	28.4	0.1	24.3	-0.3	19.8	-0.5	0.5	-0.7	-1.7
OCT 96	29.9	0.6	28.5	0.1	24.3	-0.3	20.4	-0.3	0.4	-0.1	-0.8
NOV 96	29.5	0.3	28.2	-0.2	24.3	-0.3	20.5	-1.0	-0.0	-0.5	-0.5
DEC 96	29.2	0.3	28.3	0.1	24.1	-0.8	21.8	-0.8	0.8	-0.3	-1.9
JAN 97	28.6	0.1	28.3	0.3	24.7	-0.7	23.4	-0.9	0.3	1.7	0.9
FEB 97	28.5	0.2	28.2	0.2	25.9	-0.3	25.9	0.2	1.2	1.0	-1.9
MAR 97	28.3	-0.1	28.4	0.3	27.0	0.1	27.1	1.2	-0.6	-0.5	0.9
APR 97	29.0	0.2	29.1	0.9	27.5	0.4	26.3	1.2	-1.1	0.4	2.3
MAY 97	29.5	0.4	29.4	0.9	27.9	1.3	26.5	2.6	-2.5	-2.1	0.9
JUN 97	29.6	0.3	29.3	0.8	28.1	2.0	25.7	3.0	-2.3	-0.8	2.1
JUL 97	29.5	0.3	29.4	0.9	27.8	2.6	25.5	3.9	-0.8	-0.1	1.2
AUG 97	29.0	-0.1	29.2	0.8	27.7	3.1	24.0	3.4	-2.0	-0.9	2.2
SEP 97	29.0	-0.2	29.4	1.1	27.5	2.9	24.2	3.9	-1.4	0.1	2.7
OCT 97	29.6	0.3	29.1	0.7	27.9	3.3	24.8	4.1	-1.6	-0.2	2.7
NOV 97	29.5	0.3	29.3	0.9	28.2	3.6	25.4	3.9	-1.2	0.4	2.7
DEC 97	29.1	0.2	29.2	1.0	28.3	3.4	27.1	4.5	-0.9	-0.5	1.1
JAN 98	28.3	-0.2	29.0	1.0	28.4	3.0	28.0	3.7	-2.3	-3.6	1.4
FEB 98	28.1	-0.2	28.8	0.8	28.8	2.6	28.8	3.1	-1.8	-0.9	3.5
MAR 98	28.3	-0.1	28.6	0.5	29.0	2.1	28.8	2.9	-2.5	-2.8	2.3

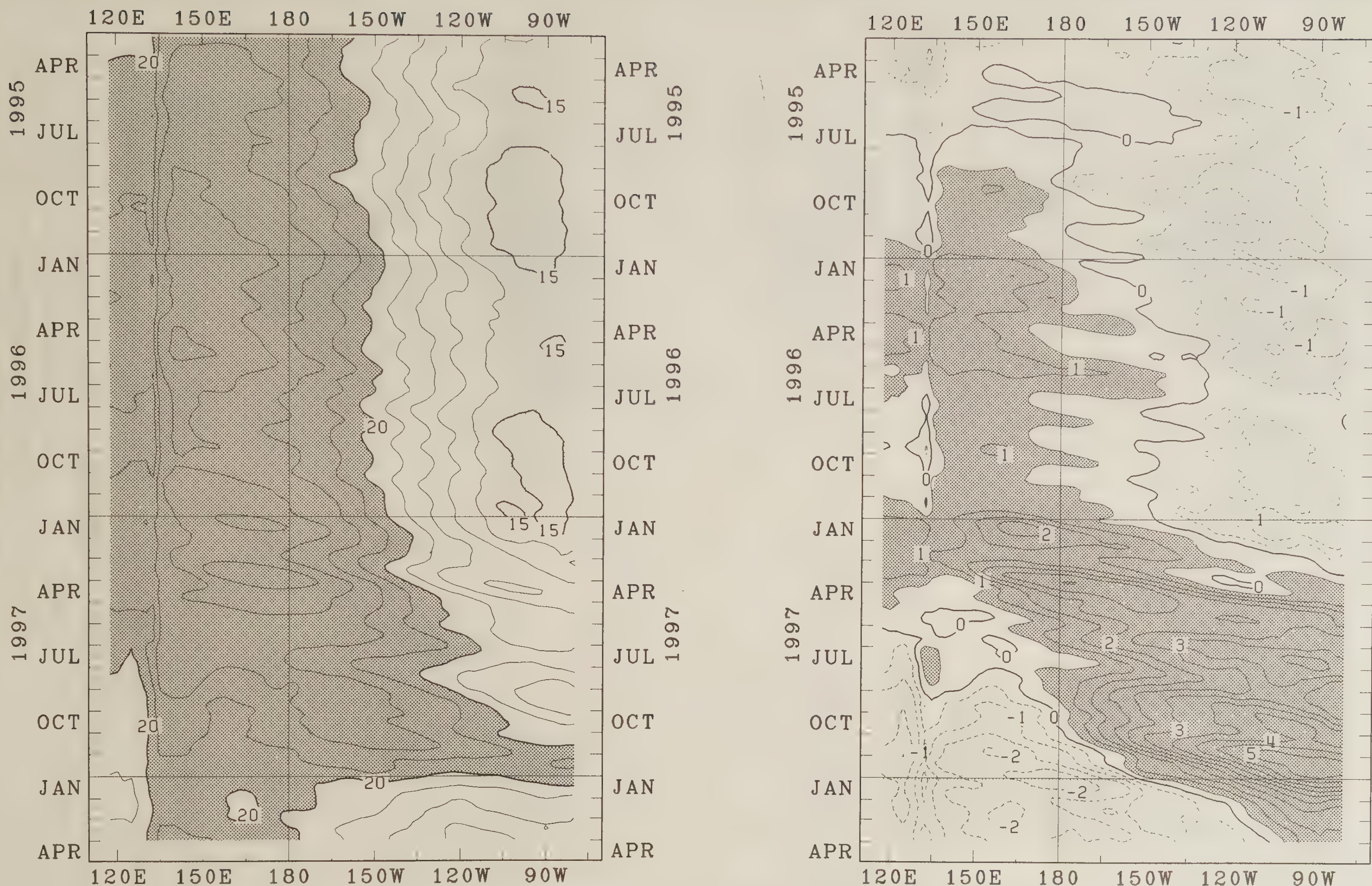
第1表　エルニーニョ監視指数

Table 1 El Nino Monitoring indices



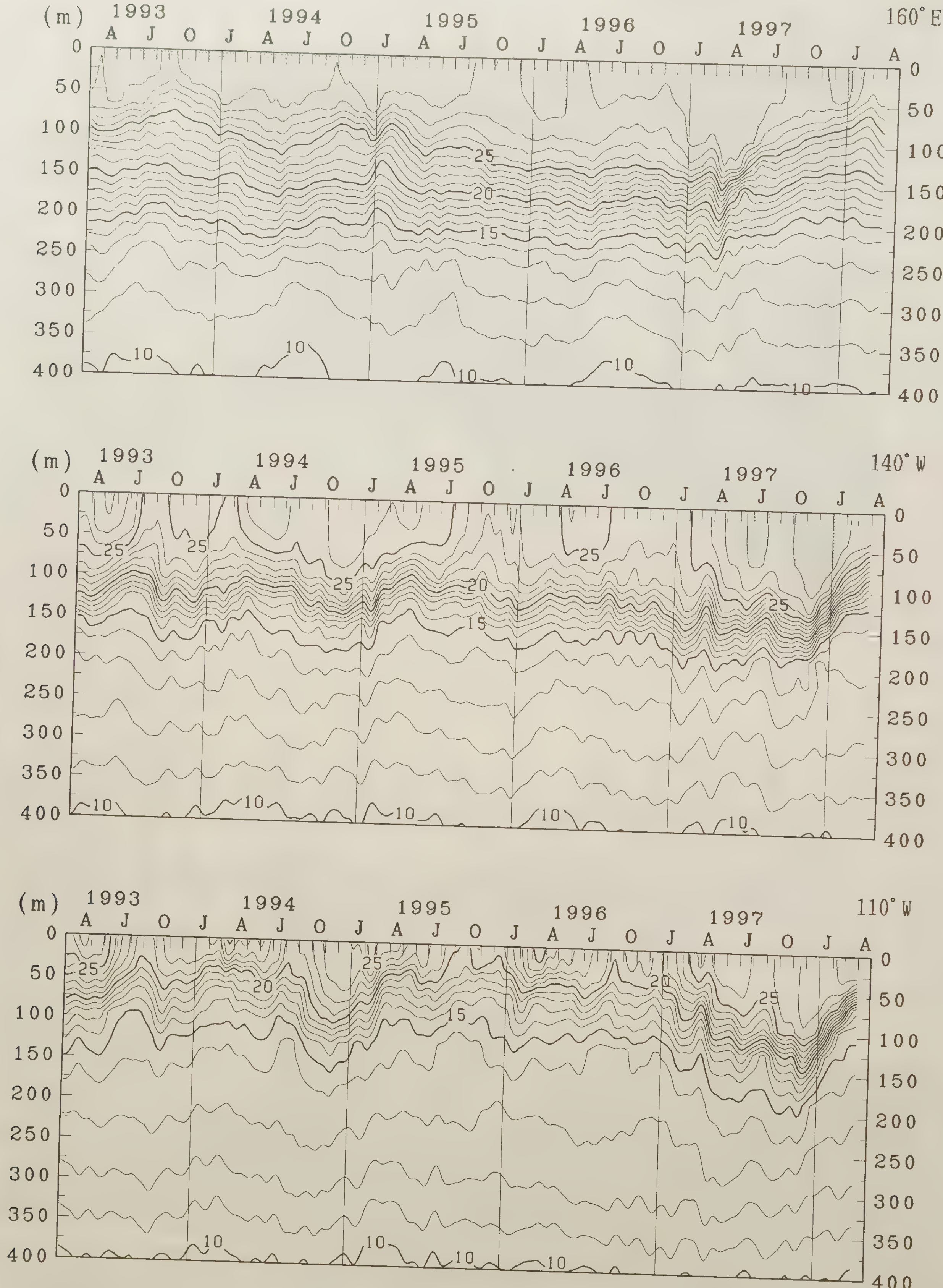
第 25 図　赤道に沿った海面水温（左）および偏差（右）の時間-経度断面図

Fig.25 Time-longitude sections of SSTs (left) and anomalies (right) along the equator (2 °N-2 °S) in the global ocean. Contour interval is 1 °C (left) and 0.5 °C (right). Values greater than 28 °C are shaded and values less than 23 °C are spotted in the left panel. Dashed contours indicate negative anomalies in the right panel. Anomalies are computed from 1961-1990 base period means.



第26図　太平洋の赤道に沿う海洋表層の貯熱量（左）及び偏差（右）の時間－経度断面図

Fig.26 Time-longitude sections of ocean heat content in the upper 260m along the equator (left) and anomalies (right) in the Pacific Ocean. Data are derived from the Ocean Data Assimilation System of JMA. Contour interval is 1°C (left) and 0.5°C (right). Values greater than 20°C are shaded and values less than 16°C are spotted in the left panel. Dashed contours indicate negative anomalies in the right panel. Anomalies are computed from 1987-1996 base period means.



第27図　太平洋赤道域の表層水温の時間－深度断面図

（上：西部、中：中部、下：東部）

Fig.27 Time-depth sections of equatorial subsurface temperature for the western Pacific (top, 160°E), the central Pacific (middle, 140°W) and the eastern Pacific (bottom, 110°W). Data are derived from the Ocean Data Assimilation System of JMA. Contour interval is 1°C. Values greater than 28°C are shaded.

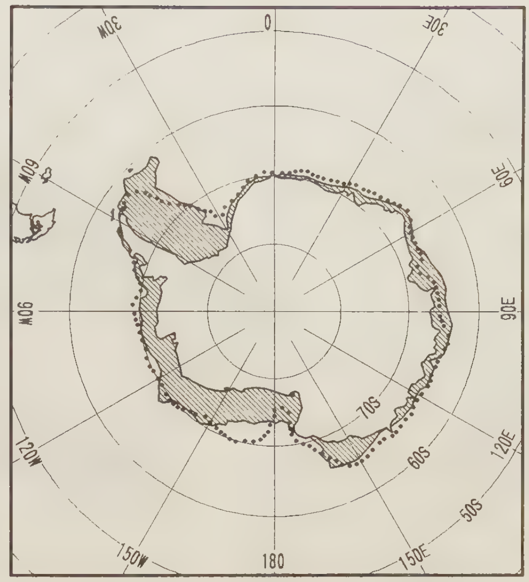


第28-1図 北極域の海氷図（1998年 3月13日）

Fig.28-1 Sea ice chart in the Arctic on 13 Mar. 1998.

The shaded area represents the sea ice extent. The dotted line denotes the mean ice edge averaged for the period from 1972 through 1990.

The data source is the National Ice Center (USA).

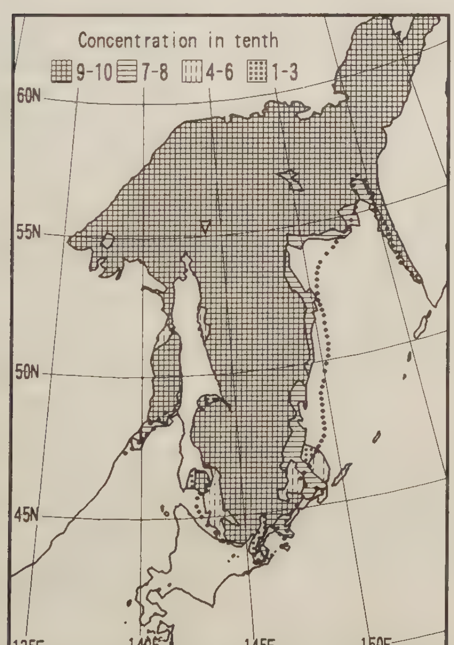


第28-2図 南極域の海氷図（1998年 3月13日）

Fig.28-2 Sea ice chart in the Antarctic on 13 Mar. 1998.

The shaded area represents the sea ice extent. The dotted line denotes the mean ice edge averaged for the period from 1973 through 1990.

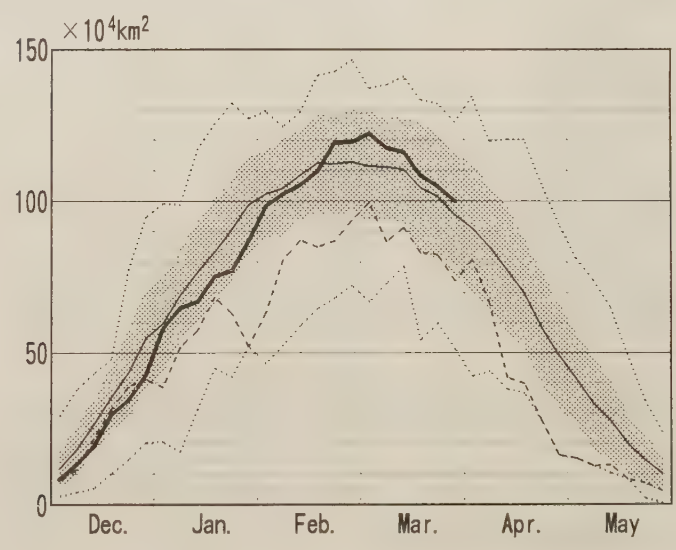
The data source is the National Ice Center (USA).



第28-3図 オホーツク海の海氷図（1998年 3月15日）

Fig.28-3 Sea ice chart in the Sea of Okhotsk on 15 Mar. 1998.

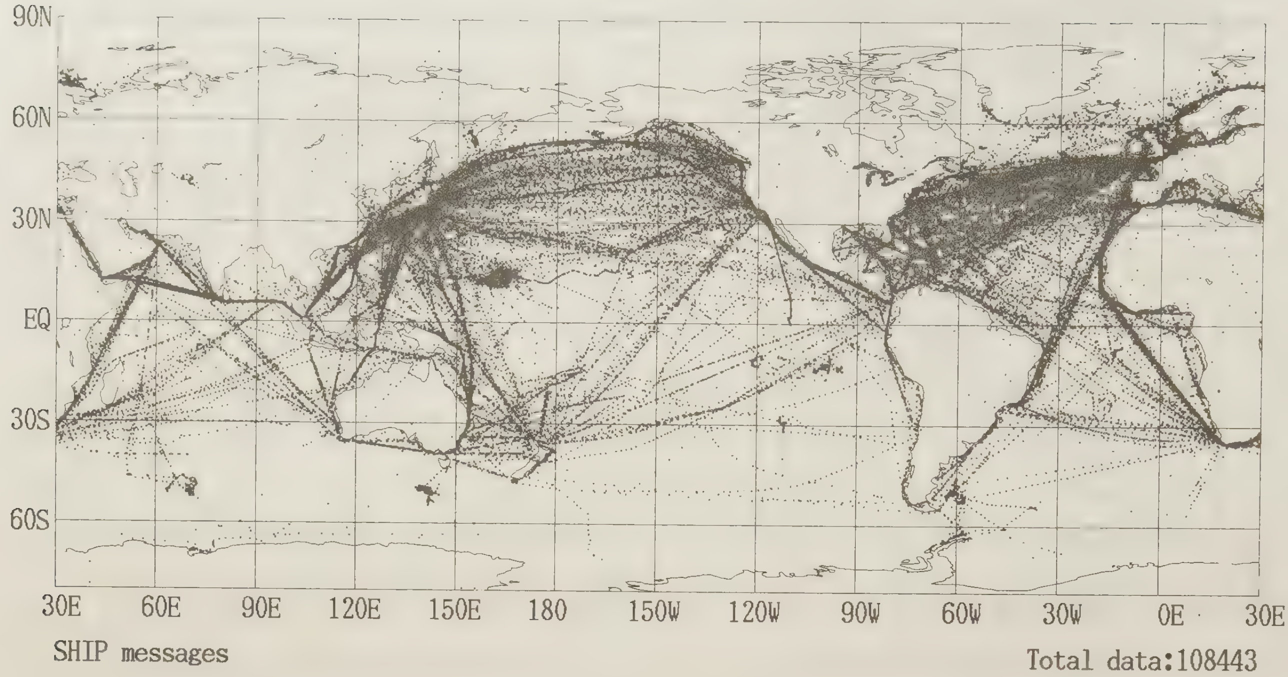
The dotted line denotes the mean ice edge averaged for the period from 1971 through 1990.

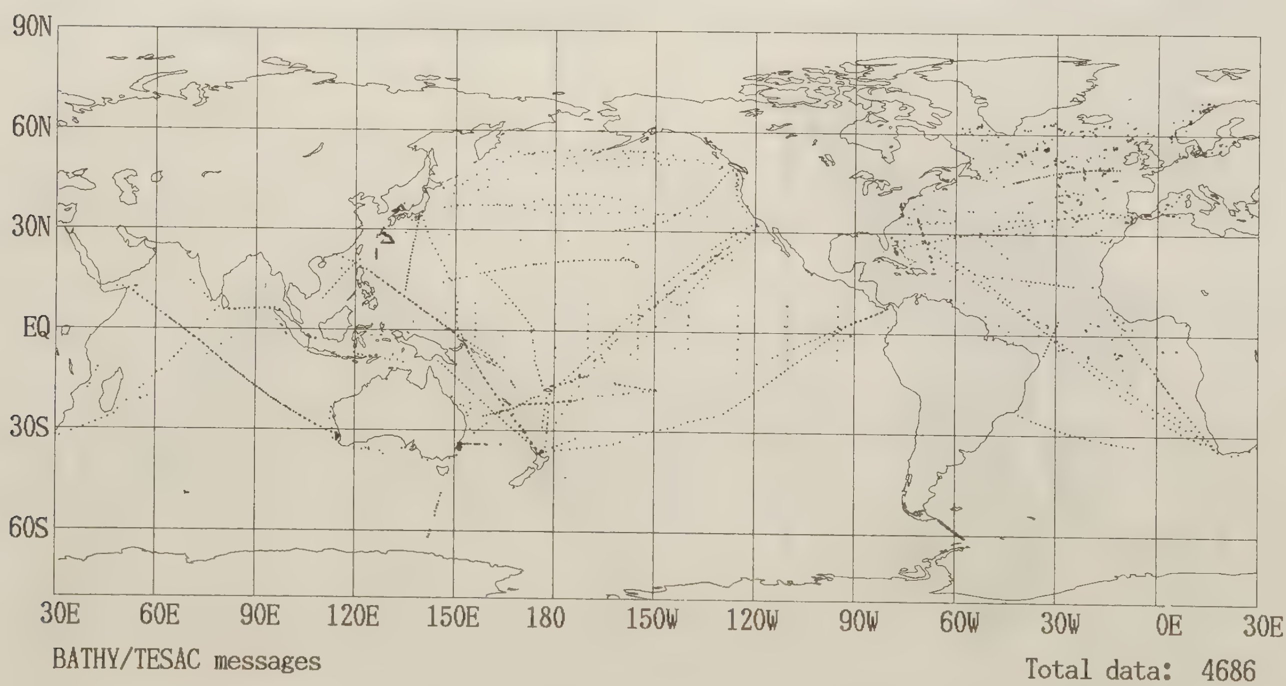


第28-4図 オホーツク海の海氷域面積（1997-1998）

Fig.28-4 Time-series of 5-day sea ice extent in the Sea of Okhotsk (1997-1998).

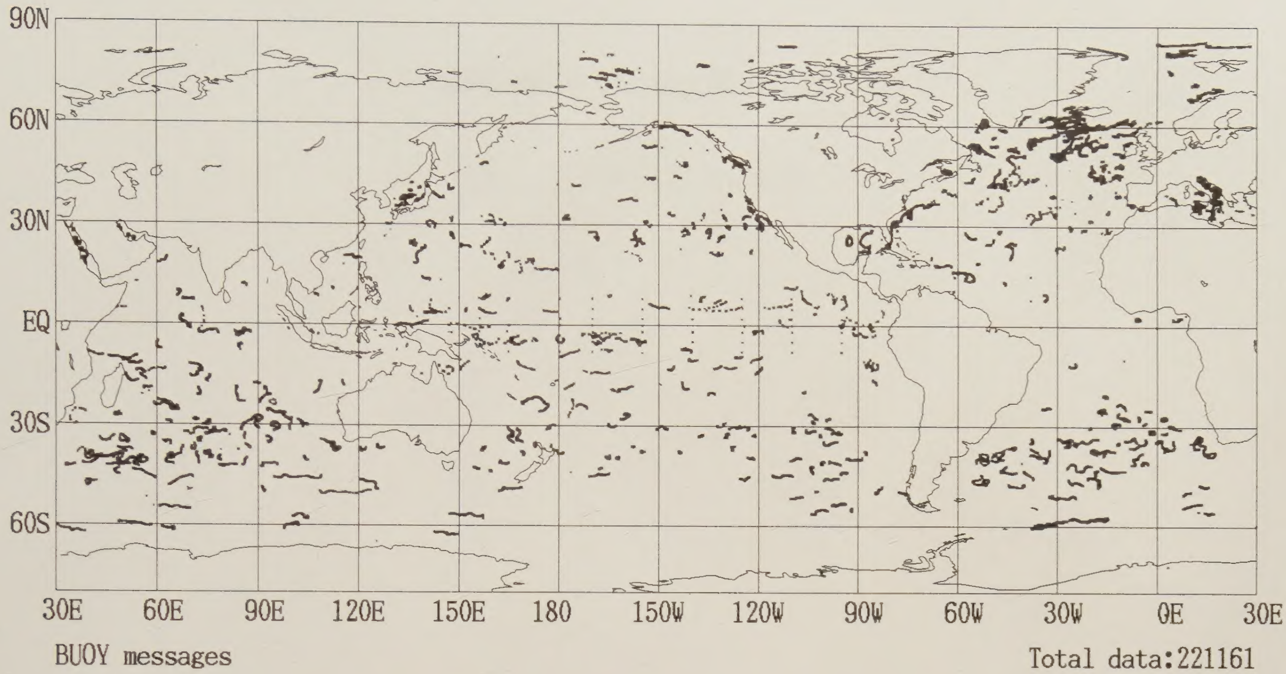
- : current season (1997/98)
- : mean extent (1971-1990)
- : maximum or minimum extent (1971-1997)
- : last season (1996/97)
- : mean $\pm 1\sigma$ (1971-1990)

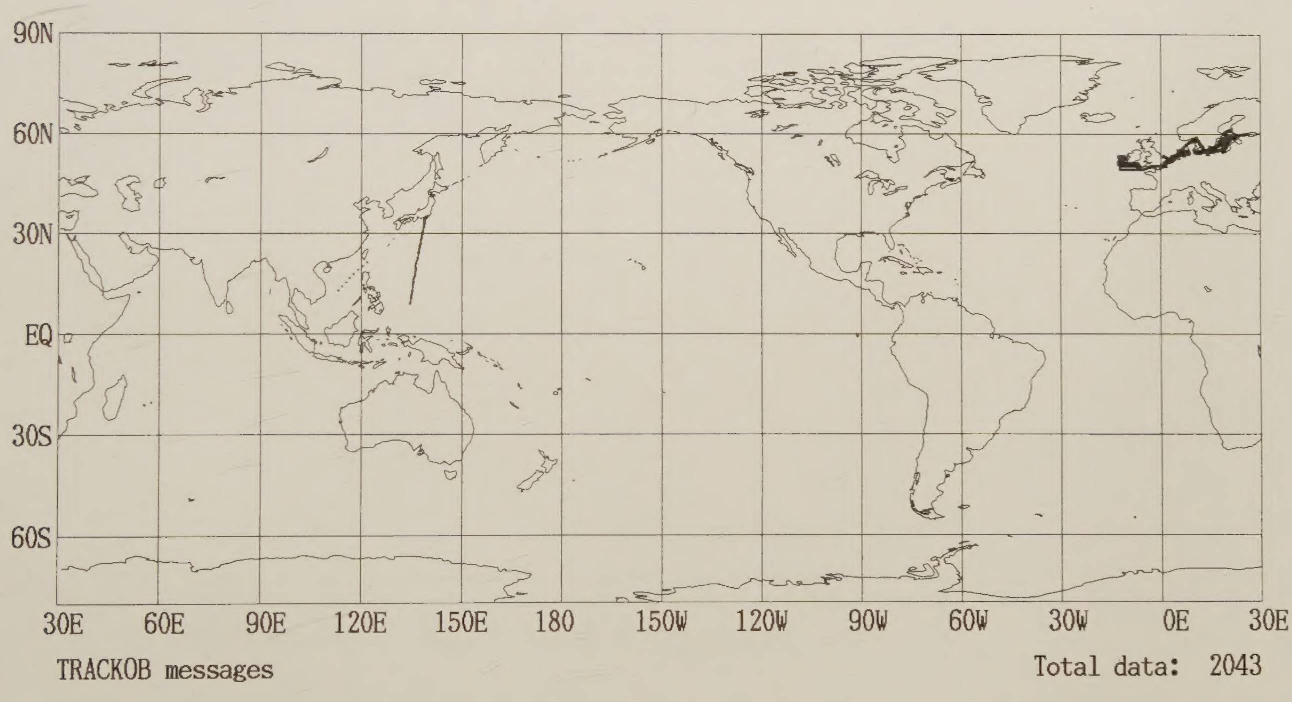




第29-1図 測点分布図(1998年 3月)

Fig.29-1 Geographical distribution of SHIP messages (SST data, top)
and BATHY/TESAC messages (subsurface temperature data, bottom)
for MAR 1998.





第29-2図　測点分布図(1998年 3月)

Fig.29-2 Geographical distribution of BUOY messages (buoy drift and SST data, top) and TRACKOB messages (ship drift and SST data, bottom) for MAR 1998.

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